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Interactive comment on "Silicon isotopes of deep-sea sponges: new insights into biomineralisation and skeletal structure" *by* Lucie Cassarino et al.

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Response to referee #3

First of all, thank you for the time taking to review the paper. On overall, I agree with the comments you have made, and I have re-worked the manuscript. I hope the corrected version and the detailed respond to your review will make it clearer. Your comments are listed, and our response/explanation will be written after it in the following paragraph.

1) I agree with reviewer 1 that a better quantification of the levels of spicule fusion would be desirable. Also an identification of the level of fusion within the table A1

in the appendix would be nice with a possible database of the SEM images for each sample. This enables the reader to get an idea of changing spicule morphology and how it is related to the apparent Si isotopic fractionation. (answer) The degree of fusion has been added into table A1. However, we did not add pictures because the table is already very large, and examples of the various degrees of fusion are given in figure 3. It is mentioned in the sample availability section that images are available upon request. This is one important aspect since from the residual plot in Figure 5d it can be seen that compared to the Demospongiae, Hexactinellida exhibit not only the lightest, but the heaviest D30Si residuals (also seen in Figure 4, although mean and median of all sponges in this group are lighter).

2) Here sponges (Hexactinellida and Demospongiae) from the location GRM 17.4306 53.1831 at 1869m show heavy values. What do spicule morphologies of these samples look like how is their degree of fusion? (answer) The fusion degree of the samples from GRM with heavy d30Sispicule are now documented in table A1 and show a F1 and F5 degree of fusion.

3) Sadly I was not able to find the sample with the second highest D30Si (figure 5c at >30uM Si(OH)4. From figure 5d it seems to be a Hexactinellida. Saying this, there is a mismatch between figure 5c and Figure 6 although both figures present all published data and all JC094 data. Also please also compare if all data presented in Figure 5c are also displayed in the residual plot 5d. (answer) There is a mismatch between figure 2, 5c and 6 because not all samples have been identified. We have clarified this point in figure 5 caption to avoid confusion.

4) Some question regarding the dissolved Si concentrations: why are the dissolved Si concentrations for e.g. samples of the GRM location always 15.96 uM although they have a distance of more than 250 km and a depth difference of 400m? (answer) Unfortunately, it was not always possible to collect co-located sponge and water samples: the water sample closed to the sponge location was analysed.

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Discussion paper

5) Can these sites, close to the mid Atlantic ridge, are affected by dissolved Si supplied by hydrothermal vents? How such a supply, although temporally, might influence the morphology of the spicules? Hydrothermal waters enriched in silica seems to promote the development of sponge growth with have thicker spicules compared to sponges that live in Si poor waters? (answer) We have not discussed the potential effect of hydrothermal supply. Sampling of waters directly above the TAG hydrothermal site did not reveal any anomalies in dissolved Si concentrations and only a very local anomaly in silicon isotopic composition of seawater (Brzezinski & Jones, 2015; Deep Sea Research Part II: Topical Studies in Oceanography volume 116); we did not sample any sponges or waters sufficiently close to any active sites to their to have been an impact on sponge growth or isotopic composition.

6) After excluding such external, environmental parameters section 4.2 and 4.3 discuss the effect of organosilicon complexes on Si isotopic fractionation. Within section 4.2 conclude that the absent "difference in the fractionation between Hexactinellida and Demospongiae classes despite the difference in their spicule composition, suggesting that the large fractionation in sponges that display a dictyonal framework is not solely a result of the organic composition of the spicules but could be controlled by the enzymes that me- diate silica deposition." However only Hexactinellida show a higher degree of fusion (figure 1). So why can the development of a silicon matrix or fusion of Si, possibly with the help of organosilicon complexes, can not be a additional Si deposition method for Hexactinellida? (answer) The end of section 4.2 has been changed to ‘' This suggests that the large Δ30Si in sponges that display a dictyonal framework is not solely a result of the differences in organic composition of the spicules but could also be controlled by the enzymes that mediate silica deposition."

7) I think that the model calculation in 4.3 is valid since differences in Si uptake parameters are between sponges are obvious and will have influence on the apparent Si isotopic fractionation. But expect one very light data at âĹij125 uM Si(OH)4 (Hendry & Robinson, 2012) Hexactinellida and Demospongiae from compiled previous publica-

tions from different oceans do show a relative small range in residual D30Si. I admire that this manuscript double the amount of available sponge Si isotope data, but if uptake parameters between sponges such a large effect on apparent Si isotope fractionation, why it has not been discovered it in the compiled previous datasets? Does this give indication that environmental parameters at some sample location presented here are different compared to previous publications? (answer) An entire section has been added "4.4 Comparison with previous studies The new data set of this study show a wide range of Δ30Si for a small range of DSi concentration compared to previous studies (figure 2) (Hendry and Robinson, 2012; Wille et al., 2010; Hendry et al., 2010). Here spicule shape, in particular the fusion stage, and Δ30Si have been investigated and are closely related, where high fusion stages show very large Δ30Si, which deviate from the existing calibration. Why has this relationship between spicule fusion and Δ30Si not been observed in previous studies? This new data set is composed of 103 samples in which 15 are deviating from the calibration and display a dyctional skeleton. Previous studies are based on fewer samples and all the hexactinellid specimens have been found, except for one, in high DSi environments (higher than 45 μM) (Hendry and Robinson, 2012; Wille et al., 2010; Hendry et al., 2010). As the spicules in Hexactinellida class can be loose, partially or totally fused, or even cemented by secondary silica (Uriz et al., 2003), it is likely that previous studies only analysed samples with loose spicules (equivalent to F1 here). Furthermore, Hendry and Robinson (2012) piblished one sample with Δ30Si = -6.52 ‰ for DSi = 125 μM (figure 2). This sample also displayed a fused skeleton but at this date the large fractionation was attributed to the lack of constraint on ambient seawater δ30Si ."

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