

## ***Interactive comment on “Silicon isotope fractionation and uptake dynamics of three crop plants: laboratory studies with transient silicon concentrations” by Daniel A. Frick et al.***

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This paper represents an interesting investigation into Si isotope fractionation in three contrasting crop plants. I am not aware that anyone has taken this approach before. I have seen that another referee has concentrated on the methodology, and I will not go over these points again. Rather I will look mostly at the interpretation of the results, and give some suggestions for improvements in the discussion.

Major Points

Line 12 and elsewhere. I am not sure that I would use "a variety of strategies (rejective,

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passive and active)." As we have come to understand Si uptake by plants it has become obvious that the different species form a spectrum. You mentioned Hodson et al. (2005) and the spectrum is very evident there. I would just say that you took species that take up Si to different extents.

Line 22. Not always at the endodermis (rice)- some species have much more dispersed transporters in the root.

Line 24 and elsewhere. The finding of significant biogenic silica deposition in the roots of mustard is novel. As far as I am aware it is the first time in a non-woody dicot. The only dicot mentioned in the recent review of silicification of roots by Lux et al. (2020) is beech. I don't think you can really just say "unpublished observations". We need to know more about this- is it endodermal deposition? A picture would help.

Line 95 onwards: Sun et al. (2019) found that while there are two Si transporter homologues present in tomato (SILsi1, a homologue of the rice LSi1 influx transporter; and SILsi2, a homologue of the rice LSi2 efflux transporter), only SILsi1 is active. They suggest that the absence of active SILsi2 explains the low levels of Si accumulation in this species.

Line 321 onwards. As already stated phytoliths in the mustard root is a novel finding, and "data not shown" is not really good enough.

Line 340 and elsewhere: I really don't like reviewers that try to increase their citations by recommending their own papers! However, there are some cases where this is justified. I am very surprised that you did not mention the work of Hodson et al. (2008) on Si isotopes in wheat. Our plants were grown in soil to maturity, and so it was a different setup. But one thing is very clear: there is significant fractionation within the wheat shoot. This does not invalidate your results, but it should be noted (our culm  $d_{30}\text{Si}$  is negative, but leaf sheaths and blades are positive leading to a positive value overall). The second point is that we also found that the lighter isotopes were deposited first. We could not measure Si in the roots because of soil contamination, but we said

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"It is apparent that there are two main routes for Si transport within the wheat plant, and that heavier isotopes increase towards the end of both routes: (1) culm » leaf sheath » leaf blade; and (2) culm » rachis » inflorescence bracts. A similar pattern was reported by Ding et al. (2005) working on rice. They considered that the process of Rayleigh fractionation explained the accumulation of heavy isotopes in the upper parts of the plant. Essentially, this would involve the lighter  $^{28}\text{Si}$  isotope being more reactive, and thus more likely to be deposited in phytoliths. Thus, in wheat, proportionately more  $^{28}\text{Si}$  isotope would be deposited in the culm phytoliths, and a greater proportion of  $^{30}\text{Si}$  and  $^{29}\text{Si}$  would continue in the transpiration stream to the leaf sheath. In the sheath the same fractionation occurs, leading to an even greater concentration of heavier isotopes in the leaf blade." This is exactly the same process that you postulate is happening in the wheat roots before Si flows on to the shoots. So our work confirms your ideas in section 4.4.

Minor correction Line 43 Yan

## References

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