

Interactive comment on “Cold season warming in the North Atlantic during the last 2000 years: Evidence from Southwest Iceland” by Nora Richter et al.

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Received and published: 20 August 2020

Richter et al. present an interesting alkenone-derived proxy dataset, which is nicely paired with a lake energy balance model to help determine proxy seasonality. However, in light of other work indicating the spring/summer seasonality of alkenones in Iceland and the known human impact on the Icelandic landscape during the last 2 ka, I think there is room for some of the text (mostly discussion) to be revised.

Alkenone seasonality: I find it difficult to rationalize the cold season bias for alkenone seasonality in VGHV given 1) the minor changes NH winter insolation anomalies (and minimal winter sunlight in Iceland) relative to NH summer insolation, and 2) that

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alkenone Uk'37 values in a Holocene lake record from NW Iceland track the first-order decrease in NH summer insolation (Harning et al., 2020). I think it would be valuable to discuss the differences between the NW and S Iceland alkenone records in terms of their relation to seasonal insolation values and what this may mean for their interpretation. Reviewer 1 mentions exploring satellite imagery as well, which I second, as it may reveal differences in the timing of ice out between NW and S Iceland that may account for some of the differences. Additionally, the authors could compare against the long instrumental temperature record from Iceland, which has been used to show that biogenic silica in a west Iceland lake (Haukadalsvatn) correlates best with April/May temperatures (Geirsdóttir et al., 2009).

Regarding the model, I imagine summer insolation values also influence the timing of ice out. If summer insolation is decreasing, could this lead to more persistent lake ice over VGHV? Several studies on North Iceland marine SST proxy records, including alkenones, have noted a similar “warming” over the last 2 ka (e.g. Moossen et al., 2015; Kristjánisdóttir et al., 2017), possibly as a function of sea ice lasting longer into the spring/summer, resulting in algal blooms occurring later in the season during relatively warmer months (e.g. Cabedo-Sanz et al., 2016). Could this possibly explain some degree of the warming observed in VGHV? If the record does indeed reflect winter warming, I'd suggest also comparing with a relatively new winter subsurface temperature record from the North Iceland Shelf (Harning et al., 2019).

Landscape disturbances: The authors mention several times that VGHV's alkenone record is not affected by additional confounding variables (e.g. L44-46, L270-273). However, culture experiments from other haptophyte species (which admittedly are not the biological source of those in VGHV) show that Uk'37 values are sensitive to additional factors, such as nutrients and light (e.g. Prahl et al., 2003). From the existing proxy records from VGHV we know that human settlement in the catchment beginning at ~1.1 ka BP had a significant impact on the surrounding landscape, including changes in vegetation (pollen) and an increased contribution of terrestrial material to

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the lake (C/N) (Blair et al., 2015). Presumably these changes could also have delivered more nutrients to the lake, so could it be possible some of the changes in alkenone unsaturation (and/or RIK37 values, L164-166) are also influenced by human-settlement-related disturbances? In addition, tephra fall can also destabilize the landscape (Larsen et al., 2011; Eddudóttir et al., 2017) so I wonder if VGHV's proximal location to the active volcanic zone and the heavy tephra loading during the last 2 ka may also impact nutrient flux and associated changes in Uk'37. In any regard, I think exploring the relationship of the new alkenone record with the existing proxy records (Blair et al., 2015) would be a valuable addition to the manuscript. As the record stands right now without the full Holocene for perspective of natural climate variability, it's difficult to confidently assign the changes observed to simply climate rather than some combination of that and human disturbances.

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Interactive comment on *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2020-84>, 2020.

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