Geochronology Discuss.,
https://doi.org/10.5194/gchron-2020-13-AC1, 2020

Interactive comment on "Delayed and rapid deglaciation of alpine valleys in the Sawatch Range, southern Rocky Mountains, USA" *by* Joseph P. Tulenko et al.

Joseph P. Tulenko et al.

jptulenk@buffalo.edu

Received and published: 15 June 2020

Reply to SC1 'forcing of glacier dynamics' from Felix Martin Hofmann

We thank the author for their comment regarding valley hypsometry, and the implication that the small differences in deglaciation reconstructions (timing, rate) between our valleys were partly attributed to this and or other non-climatic forcings. While we did not specifically use the term 'negligible', we do recognize that a 500 yr offset between Pine Creek valley and the other two valleys is notable, and each valley has slightly different net retreat rates. Our original phrasing could better reflect that:

Line 269 "We conclude that while there may have been some hypsometric influences on the timing of deglaciation across our study site, evidence suggests these influences were minimal."

In the example cited, Lukas et al. argue that topographic shielding led to a delay/standstill in the deglacial pattern for that particular glacier (i.e. not forced by climate). Here, it is curious that deglaciation initiated first for the glacier (Pine Creek valley glacier) that we might expect to have been slightly better-shielded by topography compared to the other two paleo-glaciers, which occupied larger and broader valleys. This appears contradictory to the argument that non climatic topographic shielding played a significant role. Regardless, we find that although the Pine Creek paleo-glacier may have initiated its pulse of recession ∼500 yr sooner than the other two, all three paleo-glaciers experienced a period of ∼1-1.5-kyr-long synchronous retreat once the other two glaciers began retreating.

In addition, we observe that the rates of retreat in all three valleys differ. We wonder if the rates are different as a result of valley hypsometry: the paleo-glacier in Pine Creek valley – which has the steepest average valley gradient at 65 m/km – retreated the slowest, and the paleo-glacier in Lake Creek valley retreated the fastest (37 m/km). This makes sense because a shallower and broader glacier is more sensitive to changes in ELA. We suggest this line of evidence demonstrates that valley hypsometry impacted the pace of retreat in a predictable way, which is worth highlighting.

Combined, we feel that there is sufficiently strong enough evidence to support the conclusion that while there were likely some non-climatic factors that influenced the timing of initiation and rate of retreat for these glaciers, climatic forcing is largely responsible for the significant, ∼1-1.5 kyr synchronous retreat event that took place in all three valleys.

We are adding in a brief discussion of retreat rates and average valley gradients and how the two scale, as well as appending the concluding statement highlighted at the

beginning of our response:

Starting at Line 217: “The calculated average valley gradients for each valley – measured as the elevation change divided by the horizontal length of each valley bottom transect from LGM moraine up to the base of each respective cirque – are 29 m/km for Lake Creek valley, 37 m/km for Clear Creek valley, and 65 m/km for Pine Creek valley.”

Starting at Line 269: “We also observe that Pine Creek valley has the steepest average valley gradient and the slowest net retreat rate, which is predictably a direct result of valley hypsometry since glacier lengths in steeper valleys generally adjust less to equivalent changes in ELA. On the other hand, glaciers occupying the lower-gradient Lake and Clear creek valleys experienced higher reconstructed rates of retreat. Regardless, we find that while Pine Creek may have initiated $\sim$500 yr sooner than the other two, all three valleys were in a period of $\sim$1-1.5-kyr-long synchronous retreat once the other two glaciers began retreating. We conclude that while there may have been some hypsometric influences on the timing of deglaciation across our study site, evidence suggests these influences did not keep these glaciers from synchronously retreating during a majority of their deglaciation.”

Interactive comment on Geochronology Discuss., https://doi.org/10.5194/gchron-2020-13, 2020.