

***Interactive comment on***  
**“Atmospherically-produced beryllium-10 in**  
**annually laminated late-glacial sediments of the**  
**North American Varve Chronology” by Greg Balco**  
**et al.**

**Anonymous Referee #2**

Received and published: 17 July 2020

General comments:

The manuscript by Balco et al. titled ‘Atmospherically produced beryllium-10 in annually laminated late-glacial sediments of the North American Varve Chronology’ presents an important study of multiple  $^{10}\text{Be}$  time-series from pro and paraglacial varved sediments of the NAVC at seasonal to multi-decadal resolution. Major aim is to investigate the mechanisms of  $^{10}\text{Be}$  deposition in this, for this purpose, complicated archive and synchronize the new  $^{10}\text{Be}$  records to those from Greenland ice cores. The efforts undertaken are methodologically comprehensive and of high interest for the

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geochronology community. The authors provide crucial information on the extraction and measurement of  $^{10}\text{Be}$  from sediment samples as well as aim to separate fallout (atmospheric)  $^{10}\text{Be}$  from inherited (redeposited)  $^{10}\text{Be}$  using a linear model. Therefore, I support publication of the paper in Geochronology. However, before publication one major point should be discussed and clarified.

Major point: Environmental influences on  $^{10}\text{Be}$  deposition in NAVC sediments:

All calculated bi-annual and decadal  $^{10}\text{Be}$  and  $^9\text{Be}$  flux time-series from the NAVC sediments strongly resemble changes in the mass accumulation rate (MAR) and not the variability in the originally measured  $^{10}\text{Be}$  and  $^9\text{Be}$  time-series. This is a common feature when  $^{10}\text{Be}$  flux time-series are calculated from sediment records (e.g. Berggren et al., 2013 J. Paleolim., Czymzik et al., 2015, EPSL). However, comparing the MAR with the measured  $^{10}\text{Be}$  and  $^9\text{Be}$  time-series indicates that major changes in MAR are most often not accompanied by comparable anti-phased changes in  $^{10}\text{Be}$  or  $^9\text{Be}$  (e.g. Figs. 11 and 16), suggesting that influences of changes in MAR on sedimentary  $^{10}\text{Be}$  or  $^9\text{Be}$  contents are assumedly rather small. Based on the above assumptions there might be a substantial environmental signal in the calculated  $^{10}\text{Be}$  flux and, consequently,  $^{10}\text{Be}$  fallout time-series. Please discuss this subject.

Considering the possible presence of a substantial environmental signal in the calculated  $^{10}\text{Be}$  fallout records questions the robustness of the synchronization of NAVC  $^{10}\text{Be}$  with Greenland ice core  $^{10}\text{Be}$ . Prerequisite for such studies is a reliable production rate signal in all applied  $^{10}\text{Be}$  records. This should be considered in the discussion of the synchronization and paleoclimate comparison. In addition, it would be also interesting to see how the originally measured  $^{10}\text{Be}$  concentration and  $^{10}\text{Be}/^9\text{Be}$ -ratio time-series compare with Greenland ice core  $^{10}\text{Be}$  fluxes, e.g. to evaluate how much common variability is incorporated.

Specific comments:

(1) Calendar year time-scale: The Greenland ice core chronology includes its own

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uncertainties (e.g. Muscheler et al., 2014, QSR). Therefore, in my opinion the NAVC is not synchronized to the calendar year time-scale, but to the Greenland ice core GICC05 time-scale.

(2) Page 2/28-31: In addition to the atmospheric fallout, please also mention weather and catchment effects on  $^{10}\text{Be}$  deposition.

(3) Pages 22/11 to 23/2: Please shortly discuss these two contradictory results, and their implications for the calculation  $^{10}\text{Be}$  fallout variability.

Detailed comments:

Page 1/Line 4: proglacial and 'paraglacial'? Page 3/15-16: Only one 'Ridge, 2012'? Page 3/17-24: Please provide references. Page 5/1: Please shortly describe the composition of the 'glacial sediment'. Page 5/3-8: Provide references. Page 8/2: Provide reference. Page 9/31: Provide reference. Page 18/1: Add 'and discussion' after 'results'. Figure 1: Caption: Define the abbreviations in the caption. Add information about the meaning of the long black line. Figure 14: Caption (line 2): Correct 'fallout'.

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