Jesse Zondervan (Referee comments)
Adrian Bender (Corresponding author replies)

The authors put forward a manuscript demonstrating a link between climate-induced increases in river erosion with sediment and organic carbon export and burial. The incision record is both impressive and appears robust, based mostly on previously published work by the same authors (Nat geo 2020), with some extra data from a third tributary catchment which increases the robustness of the conclusion. I find figure 2 where the authors combine incision data with their compilation of sediment and organic carbon burial convincing, and the careful burial dating and interpretation of terrace age-heigh data is refreshing. It is unlike me to give such a short review because overall, I think this manuscript is well written and has a clear message and a good dataset to support it. The message itself is well thought-out throughout the manuscript and in the introduction in particular. I agree with the authors that the mechanism of organic carbon erosion and burial is an important sink in the geological carbon cycle, perhaps even more so than silicate weathering. I do not have any comments for revision. I am impressed. I look forward to citing this work in my current manuscript.

Jesse Zondervan

The author team and I are honored by this rare review, and thank the reviewer for the thoughtful and supportive feedback. We have made no manuscript revisions in response.

Sophie Hage (Referee comments)
Adrian Bender (Corresponding author replies)

General Comments
It was a pleasure to read the study by Bender et al. who provide a new understanding of particulate and carbon export from the Yukon River to the Bering Sea, using 1) newly dated terraces along the Charley River, a tributary of the Yukon River; 2) previous work published by the same authors. The authors identify a link between Yukon River incision/export, Bering Sea sedimentation and climate, likely explaining CO_2 drawdown across the Pliocene/Pleistocene and mid-Pleistocene. The study is timely and will be of interest to a wide range of scientific communities. The paper is clearly written and concise, yet it lacks a bit of context in a few places (although I acknowledge that most of the context is provided in cited references). I find that the paper message is well documented by four clear figures (and a few useful pictures in the appendix). I have a few specific comments that may help improve the clarity of the paper.
The author team and I thank the referee for this thoughtful and thorough review, which led to revisions that we think improve the manuscript. We document revisions that aim to incorporate the helpful comments below.

Specific comments
INTRODUCTION: Please state the objectives of the paper more clearly at the end of the Introduction. This can be done in one sentence or two. It will help the reader to see the scope and context of the study upfront. In particular, it seems odd that neither the Yukon River, nor the Bering Sea are mentioned in the Introduction. A bit more context is needed as to why these settings are worthy of investigation.
We conclude the revised introduction, **Lines 63–65,** with:
"In this paper we use Pliocene–recent records of landscape erosion and marine sedimentation, preserved in terraces along several Yukon River tributaries and in Bering Sea sediment cores, to elucidate links among tectonically quiescent river incision, carbon export, and atmospheric CO_2 drawdown across profound global climate changes at 2.6 and 1 Ma."

METHODS: It would be useful to describe the aims of each of the methodological approaches carried out. How does $^{26}Al/^{10}Be$ isochron burial methods work (in a few words)?
The Methods Section 3.2 now begins with this revised paragraph, **Lines 117–126**:
"Along the Charley River (Figs. 2 and 3), a Yukon tributary, we used the cosmogenic $^{26}Al/^{10}Be$ isochron burial method to (Balco and Rovey, 2008; Zhao et al., 2016) date the latest deposition (and thus earliest incision) of 5–8 m-thick river sediments atop high (T1; three dates) and intermediate (T2; one date) terrace levels mapped up to ~150 and ~30 m above the modern channel, respectively. The isochron method requires sampling quartz-bearing sediment (i.e., cobbles, pebbles, sand) buried by several meters of stratigraphically continuous sediment (indicative of rapid burial deep enough to suppress isotope production and hence initiate decay) at a single depth horizon (indicative of common burial history). The slope of a line fit to measured ^{26}Al and ^{10}Be concentrations in quartz from these samples reflects the post-burial isotope decay from the surface production ratio, commonly approximated as 6.8 $^{26}Al/^{10}Be$ atoms though the actual ratio may vary spatially (e.g., with latitude; Halsted et al., 2021), and can therefore be used to calculate the burial duration of the sampled horizon (e.g., Balco and Rovey, 2008; Zhao et al., 2016).

Line 90: I feel that the final findings of the paper are announced too early here
Now Lines 94–97 We soften the early statement of findings by revising to:
"Here, we report the previously unknown Pleistocene incision history of the Charley River (Fig. 2). These data, along with previously documented erosion histories in other Yukon River tributaries, demonstrate erosion across at least 60,000 km^2 of the central Yukon River basin coupled to carbon burial and paleo-productivity in the Bering Sea during late Cenozoic periods of global climate change."

Line 153: How did you quantify that 85 % of the organic matter is of marine origin?

Was a mixing model used? Can it be shown/expanded in the text?
Now Lines 155–159 To describe the endmember ratio scheme we used, we revise to:
"Although higher terrigenous organic fractions likely occur on the Bering shelf nearer the Yukon River outlet, deepwater TOC sources are both terrestrial and marine; low C/N ratios that average 7.3 in deep-water sites U1341 and U1343 (Kim et al., 2016) imply organic matter predominantly (~85%) derived from marine NEP based on endmember molar C/N ratios of 5.4 and 19 for marine and terrestrial organic matter, respectively (Perdue and Koprivnjak, 2007)."

Technical corrections
Lines 101-102: Can you reword this sentence?
Now Lines 105–106 To improve clarity, we revise to:
"Field mapping and digital topography analysis underpin the cosmogenic isotope-constrained Charley River incision history we report herein."

Lines 120-123: "We designed our sample strategy to directly compare results with the previously developed Fortymile River terrace chronology (Bender et al., 2020), sampling three sites along T1 (Figs. A1–A3) to test whether the terrace age decreases upstream and one T2 site (Fig. A4) to test whether the terrace age overlaps the 0.7–1.2 Ma mid-Pleistocene climate transition as observed along the Fortymile River."
--> This sentence is hard to follow (e.g. "test whether" is used twice). Can you simplify?
Now Lines 122–126 To simplify, we revise to:
"We designed our sample strategy to directly compare results with the previously developed Fortymile River terrace chronology (Bender et al., 2020). Along the Charley River we sampled three sites on T1 (Figs. A1–A3) to test whether the terrace age decreases upstream, and sampled one T2 site (Fig. A4) to determine if the terrace dates to the 0.7–1.2 Ma mid-Pleistocene climate transition."

Line 130: remove "d" from "measured"
To maintain consistency with the rest of the methods section, which is written in past tense, we prefer to not change "measured" to "measure" as suggested.

Line 134: add "use" between "We" and "the"
Done, thanks for catching.

Line 147: What does "ages up to 4.3 Ma of %TOC" mean?
Now Lines 150–154 Refers to ages modeled for the sediment constituent quantities we interpret in the manuscript. Do decrease ambiguity we revised to:
"We model ages up to 4.3 Ma for sediment TOC (total organic carbon, weight %), weight % Al_2O_3/SiO_2 and Si_{xs} [biogenic silica, defined as weight % SiO_2 exceeding Upper Continental Crust standard (März et al., 2013)] and detrital εNd (Horikawa et al., 2015) measured in core U1341."

Lines 182 to 185: "Charley River terrace tread heights reflect incision depth, and burial ages date last fluvial deposition and thus, approximately, incision onset; these data imply that incision advanced ~140 km upstream at ~160 mm kyr-1 from 2.2 to 1.6 Ma, stalled during 1.6 to 1.1 Ma as T2 aggraded, and resumed at 1.1 Ma"
--> Can you simplify this sentence? Split in two parts?
Now Lines 187–190 To simplify, we revise to:
"Charley River terrace tread heights reflect incision depth while burial ages date last fluvial deposition and thus bracket incision onset timing. Terrace height-age data show that Charley River incision propagated ~140 km upstream at ~160 mm kyr^{-1} from 2.2 to 1.6 Ma, stalled during 1.6 to 1.1 Ma as T2 aggraded, and resumed at 1.1 Ma (Fig. 3a)."