

Reviewer #1 Evaluations:

Recommendation: Publish in present form

Significant: Yes, the paper is a significant contribution and worthy of prompt publication.

Supported: Yes

Referencing: Yes

Quality: Yes, it is well-written, logically organized, and the figures and tables are appropriate.

Data: Yes

Accurate Key Points: Yes

Reviewer #1 (Formal Review for Authors (shown to authors)):

General Comments:

The Bralower et al revised manuscript on a new Chicxulub crater drill core presents a variety of new information to reconstruct the paleoenvironment of the Chicxulub crater in the subsequent months to years to tens of thousands of years after the crater was formed. Overall I believe this to be a much improved version of the original submission that the multiple lines of evidence about the habitat of this impact crater in the aftermath of its formation is much more connected together. Specifically I appreciated the expansions of sections 3.3, 3.4, and 3.5 which go a long way in connecting more of the huge variety of details in this manuscript. Additionally, the new figures made and new versions of the original figures are clearer and more understandable, in the context of internal consistency with the manuscript text but more easy to follow from one figure to the next. I only have a couple minor comments worth considering.

We thank the reviewer for her/his previous comments that greatly improved the manuscript.

Specific Comments

(line numbers refer to clean version of resubmission)

Abstract (Line 73): I suppose you are referring to the tsunami deposits themselves here in the 'hours' end of the spectrum, as the rest of the manuscript and figures refers to the seiche deposits being formed within days to years. This is correct. Tsunami likely continued for up to days with waves after the rim and reflected waves subsided triggered by massive landslides around the Gulf of Mexico. Seiches triggered by these events would have lasted for longer, up to months.

Introduction (Line 119): how can the authors claim that LIP volcanism played no part, 'unrelated' in the K-Pg mass extinction? Many other LIP eruptions in the Phanerozoic have been linked to mass extinctions, most famously is the Siberian Traps and the EPME...why does Deccan have no relationship? These are geologically unique phenomenon just as large bolide impacts, and I just don't see how any geoscientist can simply state that either of them would have no impact on the existing biosphere at the time as there is a whole host of biogeochemical-Earth System feedbacks well established with these types of explosive volcanism.

-Seems more appropriate, less conjectural, to say that the volcanism is unrelated to the Chicxulub impact event. There are a whole host of papers that have drawn links to the Deccan Traps and this mass extinction... seems unnecessarily dismissive of this hypothesis even though it has no bearing on your data and story presented here. The other four mass extinctions were more gradual, and the end-Permian was caused by longer-term global warming from CO₂ and methane emissions from the Siberian traps. Whereas the K-Pg extinction was abrupt, the ocean chemistry and productivity remained normal up until the impact (Schulte et al., 2010)¹, and the extinctions were likely caused by (coincided with) abrupt darkening and cooling as evidenced by sea surface temperature data and climate models (e.g., Vellekoop et al., 2014)², not warming. And as a recent publication shows (Chiarenza et al 2020)³, volcanic eruptions, may have actually helped the recovery.

That said, we agree that the previous text was somewhat dismissive and thus we have provided a more complete analysis of the Deccan and its relationship with the impact in lines 48-52.

Reviewer #3 Evaluations:

Recommendation: Publish in present form

Significant: Yes, the science is at the forefront of the discipline.

Supported: Yes

Referencing: Yes

Quality: Yes, it is well-written, logically organized, and the figures and tables are appropriate.

Data: Yes

Accurate Key Points: Yes

Reviewer #3 (Formal Review for Authors (shown to authors)):

Reviewed by R. Mark Leckie, Univ. of Massachusetts Amherst

This is a well-written, thoroughly documented analysis of the biosphere response to the K-Pg impact as recorded in a remarkable succession of sedimentary deposits from the peak ring of the crater. The new stable isotope and clumped isotope paleotemperature data nicely track the biotic succession recovered in the core; the interpretation that the cooler, elevated peak ring was inhabited by survivor nannoplankton and a monospecific dinocyst assemblage illustrates how much fine detail is preserved in this record. Calcareous dinocysts in association with charcoal and the Ir-anomaly, a widely observed association, provides strong support for the hypothesis of darkness (and cooling) in the immediate aftermath of the impact. The likely implication of very rapid evolution of the earliest Paleocene planktic forams, consistent with the ^3He data, is very compelling and significant.

We thank the reviewer for her/his previous comments that greatly improved the manuscript.

The paper is ready for publication, but I have a couple of minor questions, a suggestion, and a typo.

Line 62: First key point: How can tsunami and seiche waves last months to years?: Hours to days seems more likely; how/why would such waves last any longer? Can you provide support/documentation for such protracted activity following a singular abrupt event?

The new Helium isotope data are fairly definitive that the lower part of the seiche deposit lasted months but the upper few centimeters that represents settling out from them lasted at most years as confirmed by the Ir anomaly that begins in this interval (see discussion in lines 102-108).

Line 81: Were the seiche triggered by the impact-generated tsunami, or by winds? I think it would be helpful for the reader to understand how you are differentiating between the tsunami deposit and seiche deposits. The duration of a tsunami would have been hours to days, right? Is an extreme perturbed climate, like the modeled super cooling that may have lasted for decades (Brugger et al. 2016) responsible for winds to drive a seiche during the years post-tsunami?

The seiche deposits in the crater were not driven by winds (as in modern lakes or bays for example; in the crater the seiches were deposited by waves that were internal to the crater generated as rim wave and reflected tsunami energy declined after the impact. The timing is confirmed by He isotopes and Ir data (see above).

Line 110: 'In one of the most rapid geomorphic events in Earth history...' Perhaps of of the most rapid geomorphic, biotic and environmental events in Earth history. The crater formation itself was a geomorphic event and not a biotic or environmental event. Thus we would prefer to leave this sentence as is.

Line 446: The Ir anomaly generally signifies fallout within years of the impact (Not with years of the impact). Changed.

Reviewer #4 Evaluations:

Recommendation: Return to author for minor revisions

Significant: Yes, the science is at the forefront of the discipline.

Supported: Yes

Referencing: Yes

Quality: Yes, it is well-written, logically organized, and the figures and tables are appropriate.

Data: Yes

Accurate Key Points: Yes

Reviewer #4 (Formal Review for Authors (shown to authors)):

his paper presents an impressive amount of new data on the Chicxulub crater IODP core. It is well written and the interpretations are well supported by the data. The sedimentological and clumped isotope data are novel and provide important constraints on the conditions after the impact. The authors have carefully taken in consideration the reviewer comments and modified the manuscript accordingly.

We thank the reviewer for her/his previous comments that greatly improved the manuscript.

The manuscript provides a compelling story which is well supported by the data, even if in parts its speculative. It will definitely stimulate the discussion on the aftermath of the Chicxulub impact in the literature and can be published basically as is.

I only have a few minor comments

Line 551 : should be "per meg" not " per mg"
This has been changed

Supplementary. Information:

A table with the carbon, oxygen and clumped isotopes should be added to the supplement. This is now done.

Finally we have changed the terminology of the green marlstone to be consistent with other studies. This unit is now included in Unit 1F. We have cleaned up the Figure captions, made some corrections in the Supplementary Materials and updated the references. The Bralower et al. manuscript (reference 47) is now in press in EPSL.

- 1 Schulte, P. *et al.* The Chicxulub asteroid impact and mass extinction at the Cretaceous-Paleogene boundary. *Science* **327**, 1214-1218, doi:10.1126/science.1177265 (2010).
- 2 Vellekoop, J. *et al.* Rapid short-term cooling following the Chicxulub impact at the Cretaceous-Paleogene boundary. *Proc Natl Acad Sci U S A* **111**, 7537-7541, doi:10.1073/pnas.1319253111 (2014).
- 3 Chiarenza, A. A., Farnsworth, A., Mannion, P.D., Lunt, D.J., Valdez, P.J., Morgan, J.V., Allison, P.A. Asteroid impact, not volcanism, caused the end-Cretaceous dinosaur extinction. *Proc Natl Acad Sci U S A*, doi:202006087; DOI: 10.1073/pnas.2006087117 (2020).