

REVIEWER'S REPORT

Manuscript No.: IJAR-58977

Title: QUATERNARY VOLCANIC ERUPTION TOBA ASH FALL ITS IMPACTS ON ENVIRONMENT OF LATE PLEISTOCENE HOMININES IN INDIAN SUBCONTINENT WITH SPECIAL REFERENCE TO NARMADA VALLEY, INDIA.

Recommendation:

Accept as it is

Rating	Excel.	Good	Fair	Poor
Originality		√		
Techn. Quality		√		
Clarity		√		
Significance			√	

Reviewer's ID: JPR-006

Detailed Reviewer's Report

1. The main objective of this work is to investigation

The Toba volcanic ash eruption (~74 ka) and its environmental impacts on Late Pleistocene hominines in the Indian subcontinent, with special reference to the Narmada Valley. It aims to examine the stratigraphic occurrence and characteristics of the NAB-I and NAB-II ash horizons and their relationship with archaeological and fossil deposits. The study also seeks to assess the role of Toba ash in palaeoenvironmental changes, climatic deterioration, and human population/migration patterns.

2. Scientific Relevance of the Study

The manuscript addresses a highly significant Quaternary geological and environmental event, namely the Toba super-eruption. Its focus on the Indian subcontinent and particularly the Narmada Valley makes the study geographically and scientifically important. The work successfully connects volcanic activity with environmental and archaeological evidence. This interdisciplinary approach enhances the overall significance of the manuscript.

3. Strong Interdisciplinary Approach

A major strength of the manuscript is its integration of geology, volcanology, palaeontology, archaeology and palaeo environmental interpretation. The authors attempt to understand the Toba event from both geological and human-evolution perspectives. Such integration provides a broader understanding of Late Pleistocene environmental changes. The interdisciplinary nature significantly increases the potential readership of the work.

4. Importance of the Toba Super-Eruption

The manuscript provides an informative discussion of the approximately 74 ka Toba eruption and its exceptional magnitude. The eruption is presented as an important Quaternary geological event with potentially extensive environmental consequences. The discussion appropriately considers both atmospheric and terrestrial effects. This provides an important background for understanding subsequent environmental changes.

5. Special Importance of the Narmada Valley

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The selection of the Narmada Valley as the principal study region is particularly appropriate. The valley contains extensive Quaternary sedimentary sequences and important archaeological and palaeontological records. The manuscript highlights the occurrence of volcanic ash within these sedimentary sequences. This makes the Narmada Valley an important natural archive for investigating Late Pleistocene environmental history.

6. Valuable Documentation of Ash Horizons

The identification and discussion of the two major ash horizons, NAB-I and NAB-II, is one of the important contributions of the manuscript. The manuscript describes their stratigraphic positions and association with different sedimentary units. The recognition of multiple ash horizons provides useful evidence for understanding volcanic ash deposition. These horizons may also provide valuable markers for regional Quaternary correlation.

7. Stratigraphic Significance of NAB-I and NAB-II

The manuscript provides useful information regarding the occurrence of NAB-I and NAB-II at different stratigraphic levels. NAB-I is associated with the Hathnora formation, whereas NAB-II occurs within younger deposits. The separation of the two horizons provides an interesting basis for interpreting different phases of ash deposition. This stratigraphic framework adds considerable value to the geological interpretation.

8. Useful Glass-Shard Morphological Observations

The examination of glass-matrix and glass-shard morphology is an important aspect of the study. The manuscript considers the shape, size, texture and relationship of glass fragments with associated minerals. These characteristics are discussed as diagnostic indicators of siliceous volcanic activity. Such microscopic evidence provides useful support for identifying and interpreting the volcanic material.

9. Evidence for Long-Distance Ash Transport

The manuscript presents an interesting interpretation of the transport of volcanic material through atmospheric and aeolian processes. The ash is considered to have travelled from the distant volcanic source as a large atmospheric cloud. Its subsequent deposition within different river-valley sedimentary environments is particularly significant. This interpretation helps explain the widespread occurrence of Toba-related tephra across the Indian region.

10. Regional Correlation Potential

The similarity of the described glass-shard characteristics with Quaternary tephra reported from other Indian basins is an important observation. The manuscript refers to occurrences in the Narmada, Son, Purna and Kukdi basins. Such similarities indicate the potential of volcanic ash as a regional stratigraphic marker. This can contribute to broader correlation of Quaternary deposits across the Indian subcontinent.

11. Contribution to Quaternary Sedimentation Studies

The manuscript provides useful information on the complex Quaternary sedimentation history of the Narmada Valley. The discussion of glacial, fluvio-glacial and fluvial sedimentary domains adds geological context to the ash deposits. The thick sedimentary sequence provides an excellent archive of environmental changes. The study therefore contributes to understanding the geological evolution of the Central Narmada Valley.

12. Archaeological Significance

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The association of volcanic ash with Paleolithic archaeological contexts is an important feature of the manuscript. The Narmada Valley contains numerous archaeological occurrences and stone-tool assemblages. The manuscript attempts to place these archaeological records within the broader environmental framework of the Toba event. This provides an important connection between geological deposits and prehistoric human activity.

13. Palaeoanthropological Importance

The discussion of Homo erectus and other hominine evidence gives the manuscript considerable palaeoanthropological relevance. The Narmada hominine remains are discussed in relation to the Quaternary sedimentary sequence and volcanic ash horizons. This provides an interesting opportunity to examine human occupation during a period of major environmental change. The integration of fossil evidence with geological observations strengthens the interdisciplinary character of the study.

14. Association with Hathnora Formation

The association between the Hathnora formation, volcanic ash and the Narmada hominine record is particularly noteworthy. The manuscript places the fossil evidence within a well-developed Quaternary sedimentary framework. This association provides useful contextual information for interpreting the environmental conditions experienced by ancient hominines. It represents one of the scientifically interesting aspects of the manuscript.

15. Consideration of Environmental Consequences

The manuscript gives considerable attention to the possible environmental consequences of the eruption. It discusses volcanic dust, gases and atmospheric effects in relation to climatic deterioration. The study thereby connects geological evidence with potential ecological consequences. This environmental perspective is valuable for understanding the broader significance of major volcanic eruptions.

16. Discussion of Volcanic Winter Hypothesis

The manuscript provides an informative discussion of the proposed volcanic-winter mechanism following the Toba eruption. It explains how large quantities of volcanic aerosols and dust could influence atmospheric and climatic conditions. The comparison with climatic consequences of other major eruptions provides useful scientific context. This section contributes to understanding the possible climatic significance of the event.

17. Recognition of Scientific Debate

Another positive aspect is that the manuscript does not completely ignore the controversy surrounding the magnitude of Toba's climatic and demographic effects. It recognizes that researchers have debated whether the consequences were global, regional or localized. This demonstrates awareness of the complexity of interpreting the Toba event. The inclusion of alternative scientific perspectives improves the conceptual breadth of the manuscript.

18. Human–Environment Interaction

The manuscript provides an interesting perspective on the interaction between prehistoric human populations and environmental disturbances. It considers how volcanic ash deposition and associated environmental changes could have influenced available habitats and resources. The connection between environmental change and human adaptation is particularly relevant to Quaternary research. This perspective gives the study significance beyond purely geological investigations.

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19. Importance of Paleolithic Technology

The discussion of Paleolithic stone-tool industries adds an important archaeological dimension to the study. The manuscript recognizes the presence of Middle and later Paleolithic technological traditions in South Asia. The relationship between archaeological assemblages and environmental events provides an important avenue for understanding human adaptation. This strengthens the manuscript's relevance to prehistoric archaeology.

20. Potential for Regional Environmental Reconstruction

The combination of ash deposits, sedimentary sequences, fossil evidence and archaeological remains provides a valuable framework for reconstructing past environments. The manuscript demonstrates how different geological and archaeological records can be considered together. Such an approach has strong potential for developing a more comprehensive picture of Late Pleistocene environmental conditions. The Narmada Valley is therefore effectively presented as an important palaeoenvironmental archive.

21. Contribution to Understanding Human Dispersal

The manuscript discusses different hypotheses concerning the timing and routes of *Homo sapiens* dispersal into the Indian subcontinent. This is particularly relevant because the proposed dates overlap closely with the Toba eruption. The comparison of genetic, archaeological and environmental evidence creates an interesting interdisciplinary discussion. The manuscript therefore contributes to an important question in South Asian human evolutionary research.

22. Usefulness of Tephra as a Correlation Tool

The manuscript appropriately highlights the potential of volcanic ash layers as chronological and stratigraphic correlation markers. Distinct ash horizons can assist in comparing sedimentary sequences from geographically separated locations. The recognition of multiple ash horizons in the Narmada Valley is therefore particularly valuable. This aspect could be useful for future Quaternary geological and archaeological investigations.

23. Broad Geographical Perspective

Although the Narmada Valley is the primary focus, the manuscript places the observations within the wider Indian subcontinental context. References to ash occurrences in other river basins provide useful regional perspective. The broader geographical approach helps demonstrate that Toba-related deposits were not restricted to a single locality. This increases the potential significance of the study for South Asian Quaternary research.

24. Potential Value for Future Research

The manuscript brings together several observations that can serve as a foundation for future multidisciplinary investigations. The ash horizons can be further investigated through geochemical, mineralogical and chronological techniques. Likewise, archaeological and palaeoenvironmental evidence can be integrated with improved dating frameworks. Thus, the study has considerable potential to stimulate further research on Toba and Late Pleistocene environments.

25. Overall Contribution to Quaternary Science

Overall, the manuscript makes a valuable contribution by bringing together geological, environmental and archaeological evidence related to a major Quaternary eruption. Its special emphasis on the Narmada Valley provides a useful regional case study. The documentation of ash horizons and their relationship

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with Quaternary sediments and hominine evidence is particularly noteworthy. The study has clear relevance to researchers working in Quaternary geology, archaeology and palaeoenvironmental sciences.

26. Recommendation

The manuscript addresses an important and scientifically interesting research topic with substantial interdisciplinary relevance. The Narmada Valley evidence, particularly the NAB-I and NAB-II ash horizons and their association with archaeological and palaeontological records, represents a significant strength. The manuscript provides a useful synthesis of Toba volcanism, environmental change and Late Pleistocene human occupation.