

This manuscript reviews the field occurrence of Australasian tektites at the geological and archaeological sites in Southeast Asia and Australia. The authors suggest that it should be very cautious to use tektites as a proxy for establishing the chronology of an archaeological deposit since the archaeological strata in which tektites are found are often much younger in chronological age than the tektites themselves.

This manuscript seems to be an important contribution to the controversy whether the Australasian tektites found at archaeological sites can represent the age of artefacts in the deposit, or not. The conclusion is not surprising and seems not to have much novelty, but the literature reviews contain a lot of important information for researchers who have an interest in this topic.

However, there are several unclear points in the manuscript and many minor careless mistakes. I provide below some major and minor comments.

### **Major comments**

★ Throughout the manuscript, it is not clear that this manuscript contains only reviews of literature or contains some results of the author's field surveys at the archaeological sites in addition to the literature reviews. There are some sentences that seem to mean the authors conducted field surveys in the archaeological sites, such as line 17 (p.1) "*We describe five archaeological sites...*", line 219 (p.10) "*...in this section, we describe finds of tektites...*", line 221(p.10) "*We report on finds of tektites at five archaeological sites...*", and line 303 (p.14) "*Our brief survey of five sites...*". On the other hand, line 32 (p.2) "*In this paper, we review the geological and archaeological contexts of tektites...*" seems to mean that this manuscript is composed only of literature reviews. I was much confused during reading the manuscript. It should be clarified which part is literature reviews and which part is the author's data. Below are specific points and proposals for improvement.

- line 32-36 (p.2) "*In this paper we review the geological and archaeological contexts of tektite finds in SEA to evaluate the reliability of the Middle Pleistocene ages claimed for the An Khe sites. We review the geological evidence for the stratigraphic ages of tektites and mainland SEA. We report on a selection of recent archaeological finds of tektites in Vietnam.*" may be better as "*In this paper we review the literature and report our recent field surveys on the geological and archaeological contexts of tektite finds in Australasia to evaluate the reliability of the Middle Pleistocene ages claimed for the*

An Khe sites. *First, we review the geological evidence for the stratigraphic ages of tektites in mainland SEA and Australia. Then, we report on a selection of our recent archaeological finds of tektites in Vietnam.*” to clarify the structure of the manuscript.

- line 64 (p.3) “*In the following section we briefly survey a selection of tektite finds in Australasia*” should be “*In the following section we briefly review a selection of tektite finds in Australasia*” to make it clear that the next section is a literature review.
- line 219 (p.10) “*...in this section, we describe finds of tektites...*” may be better as “*...in this section, we describe our recent finds of tektites...*” if this section contains the results of the author’s field survey.
- line 221(p.10) “*We report on finds of tektites at five archaeological sites...*” may be better as “*We report on our recent finds of tektites at five archaeological sites...*” if this section contains the results of the author’s field survey.
- line 241-248 (p.11) “*The stone tool assemblage...elsewhere in Vietnam.*” It is not clear that this paragraph is a literature review or report of the results of the author’s field survey. If it is a literature review, this paragraph needs references. If it is a report of the results of the author’s field survey, it should be clearly stated.
- line 280-282 (p.13) “*Bronze coins found.... Further excavations in...*” It is not clear that these sentences are a literature review or report of the results of the author’s field survey. If they are a literature review, these sentences need a reference.
- line 348-350 (p.16) “*Our results from Vietnam show that the archaeological strata and contexts in which tektites are found are often much younger in chronological age than the tektites themselves.*” may be better as “*Our results from Vietnam and literature reviews show that the archaeological strata and contexts in which tektites are found are often much younger in chronological age than the tektites themselves.*”

★In line 76-80 (p.4), the authors introduce Fiske et al. (1999). However, the objective observation results described in Fiske et al. (1999) and the interpretation by Fiske et al. (1999) are written in a mixture. The objective data and the interpretation should be described separately. Fiske et al. (1996) and Fiske et al. (1999) interpreted the gravel layer as a lag deposit, the upper surface of the gravel layer as a paleo-erosional surface,

and the tektites in the gravel layer as redeposition. However, their interpretation is based only on their visual observation of the gravel layer in the field. Despite concluding that the tektites are reworked, Fiske et al. (1996) also noted that there was little evidence that the tektite fragments have undergone significant lateral transport. Their interpretation is not based on enough evidence. In addition, I think, Fiske et al. (1999) does not mention any “diamondiferous compound” in their paper. Below are specific points and proposals for improvement.

- line 76-80 (p.4) “*However, their survey also confirmed that the majority of tektites in Laos and Vietnam are not in situ, but are positioned atop a lag layer, and have probably been transported, exposed, and reburied. The lag layer is composed of loose gravel, often mixed with diamondiferous compounds or high levels of organics. It appears to represent a palaeo-erosional surface, which was likely eroded and recovered repeatedly over the course of the Pleistocene.*” may be better as “*However, they interpreted that the majority of tektites in Laos and Vietnam are not in situ and have probably been transported, exposed, and reburied. The tektites were found atop a loose gravel layer, which they interpreted as a lag deposit. It was interpreted as representing a palaeo-erosional surface, which was likely eroded and recovered repeatedly over the course of the Pleistocene (Fiske et al. 1996; 1999).*”
  - line 104 (p.5) “*Nevertheless, they are important because of the sedimentary contexts of the finds: they are consistently found in pebbly laterite lag deposits, indicative of deflationary and erosional processes that have displaced the tektites from their original context.*” may be better as “*Nevertheless, they are important because of the sedimentary contexts of the finds: they are consistently found in pebbly laterite deposits, possibly indicative of deflationary and erosional processes that have displaced the tektites from their original context.*”
  - line 117 (p.6) “*These Southeast Asian locations are examples of where...*” may be better as “*These Southeast Asian locations are possible examples of where...*”.
- ★ To maintain the neutrality and objectivity of the literature review, it is better to mention literature suggesting that the tektites found in the “laterite” layer in SE Asia are *in situ*, as well as literature suggesting that the tektites are reworked. Although Tada et al. (2020) is mentioned in the Implication and Conclusion sections, it is better to mention it briefly also in the section “Tektites in the terrestrial geological record in Australasia”.

- line 137 (p.6) "...tektites are more often found in secondary rather than primary deposits..." should be "...tektites are more often found in secondary **or controversial** rather than primary deposits...".

★As for Figures 3, 4, 5, and 6, it is hard to discern whether these objects are really tektites or not from the photographs alone. The bottom left and the bottom right of Figure 3 look stony rather than glassy, and Figure 4 looks like volcanic glass such as obsidian, although the other photographs look like tektites. It is better to add evidence to demonstrate that these objects are tektites such as geochemical data or radiometric date of the glass or water content. If it is difficult to obtain these data, high-resolution photographs or enlarged photographs are very welcome.

### **Minor comments**

- The age of the Australasian tektite event is referred to as "0.78 Ma" (line 12, p.1; line 31, p.2), "0.73 – 0.77 Ma" (line 59, p.3; line 63, p.3), and "c. 800 ka" (line 305, p. 14) in the manuscript. The recent and accurate radiometric date of the Australasian tektite is  $788.1 \pm 3.0$  ka reported in Jourdan et al. (2019). It is better to cite at least Jourdan et al. (2019) to refer to the age of the Australasian tektite event. Below is the literature information of Jourdan et al. (2019).

*Jourdan, Fred, et al. "Ultraprecise age and formation temperature of the Australasian tektites constrained by  $^{40}\text{Ar}/^{39}\text{Ar}$  analyses." *Meteoritics & Planetary Science* 54.10 (2019): 2573-2591.*

- line 43 (p.2) "Tektites are small, black, glassy, gravel-sized minerals..." should be "Tektites are small, black, glassy, gravel-sized **objects**... (Koeberl 1994)". Tektites are composed entirely of glass and thus they are not minerals. In addition, this sentence needs a reference. I suggest Koeberl (1994). Below is the literature information.

*Koeberl C (1994) Tektite origin by hypervelocity asteroidal or cometary impact. In: Dressler BO, Grieve RAF, Sharpton VL (eds) Large meteorite impacts and planetary evolution: Geological Society of America special paper 293. Geological Society of America, Colorado. <https://doi.org/10.1130/SPE293-p133>*

- line 47 (p.3) "As the molten sediment travelled through the air..." should be "As the molten **rocks and deposits** travelled through the air..." since the molten material is not necessarily sediment.

- line 49 (p.3) "...whose exact impact location is unknown, but may be in the Gulf of Tonkin." should be "...whose exact impact location is unknown, but estimated to be somewhere in the eastern part of the Indochina Peninsula (e.g., Sieh et al. 2020)." The exact location of the impact is not known, but the Gulf of Tonkin is not a consensus between geologists. The most plausible hypothesis is Bolaven Plateau in southwestern Laos (Sieh et al. 2020). Nevertheless, most geologists have a consensus that the location of the impact is at least somewhere in the eastern part of the Indochina Peninsula. In addition, this sentence needs a reference. I suggest Sieh et al. (2020). Below is the literature information.

*Sieh, Kerry, et al. "Australasian impact crater buried under the Bolaven volcanic field, Southern Laos." Proceedings of the National Academy of Sciences 117.3 (2020): 1346-1353.*

- line 69 (p.3) "Tektites in the terrestrial geological record in Australasia" should be "Tektites in the geological record in Australasia" since the word "terrestrial" is not necessary.
- line 74 (p.4) "...Fiske et al. argue that their excavation..." should be "...Fiske et al. (1999) argue that their excavation...". There are several Fiske et al. cited in the manuscript. It is better to make it clear which Fiske et al. is mentioned here.
- line 82 (p.4) "...and Australia (Langbroek 2014, 176)." should be "...and Australia (Langbroek 2014, 176; Tada et al. 2020)." Tada et al. 2020 also summarize the stratigraphic occurrence of the tektites across Indochina. It is better to cite it here.
- line 84 (p.4) "In Laos, Fiske et al...." should be "In Laos, Fiske et al. (1999)...". There are several Fiske et al. cited in the manuscript. It is better to make it clear which Fiske et al. is mentioned here.
- line 104 (p.5) "...reported by Fiske et al." should be "...reported by Fiske et al. (1996, 1999)." There are several Fiske et al. cited in the manuscript. It is better to make it clear which Fiske et al. is mentioned here.
- line 110 (p.5) "C14 ages" should be "<sup>14</sup>C ages".

- line 112 (p.5) “*The lag deposits at the Borneo sites, however, have a younger stratigraphic age...than the tektites found within (Fiske et al. 1996, 1999).*” should be “*The lag deposits at the Borneo sites, thus, have a younger stratigraphic age...than the tektites found within.*” The term “however” is used in the manuscript but, I think, the relationship of this sentence with the former sentence is resultative rather than adversative. In addition, Fiske et al. (1996, 1999) are not appropriate references for the depositional age of the gravel deposit at Borneo.
- line 129 (p.6) “*Fudali (1991; 1993)*” should be “*Fudali et al (1991) and Fudali (1993)*”.
- line 130 (p.6) “*Fudali (1991)*” should be “*Fudali et al (1991)*”.
- line 152 (p.7) “*...three tektites collected in situ in the same stratigraphic layer...*” should be “*...three tektites collected in the same stratigraphic layer...*” since whether these tektites are *in situ* or not is controversial.
- line 185 (p.9) “*...that were also identified on tektites from Central Europe.*” This sentence needs a reference.
- line 232 (p.11) “*...1973 (480m<sup>2</sup>), 1980 (363m<sup>2</sup>) and 1990 (156m<sup>2</sup>, Tan et al, 1999).*” should be “*...1973 (480 m<sup>2</sup>), 1980 (363 m<sup>2</sup>) and 1990 (156 m<sup>2</sup>, Tan et al, 1999).*”
- line 262 (p.12) “*700m<sup>2</sup>*” should be “*700 m<sup>2</sup>*”.
- line 263 (p.12) “*Son, 2015*” should be “*Son 2015*” to standardize the way to write citations through the manuscript.
- line 263 (p.12) “*3m*” should be “*3 m*”.
- line 266 (p.12) “*Son, 2015*” should be “*Son 2015*” to standardize the way to write citations through the manuscript.
- line 266 (p.12) “*2.5m*” should be “*2.5 m*”.
- line 269 (p.12) “*The excavators conclude that the tektite was brought into the cave when raw materials were transported to the site...*” It is not clear that who (or what)

bring the tektite. Please make it clear in this sentence.

- line 270 (p.12) “*Son, 2015*” should be “*Son 2015*” to standardize the way to write citations through the manuscript.
  - line 484 (p.24) “*2m*” should be “*2 m*”.
  - line 490 (p.25) “*1x1m*” should be “*1 x 1 m*”.
  - line 490 (p.25) “*10mm*” should be “*10 mm*”.
  - The scales in the photograph of the artefact in Figure 4 are too small.
  - The excavation site photograph in Figure 4 needs a scale.
  - The drawing of glazed ceramics in Figure 6 needs a scale.
- ★ There are many problems with the reference list. Some references in the list are not cited in the main text and many references cited in the text are not in the reference list. Below are specific points.
- Baker (1962), Khenthavong and Xuan (1999), Hakari et al. (1992), and Lovering et al. (2007) are not cited in the main text while they are in the reference list.
  - Deng et al. (2007), Langbroek (2014), Michel et al. (2021), Son (2014), Son (2016), Son et al. (2016), Son (2017), Tada et al. (2020), Wang et al. (2012), and Xie et al. (2021) are missing in the reference list while they are cited in the main text.