Short comment on Mouslopoulou et al.

Mouslopoulou et al. present a geomorphic and geochronologic study of a fan sequence located at the mouth of the Klados River Gorge (Domata Beach) in southern Crete. Using field studies, GPS surveys, and luminescence dating the authors try to untangle the origin and significance of this spectacular fan sequence. The authors' field investigations suggest that the fan sequence is a composite of two inset fans and differences in soil color are interpreted to reflect different ages of each fan surface. Luminescence dating is employed to constrain the age and timing of fan aggradation and incision episodes. Quartz OSL is unsuccessful, but IRSL of feldspars is argued to be reliable and suggests fan deposition at ~25-55 ka. The authors use this data coupled with a sea level curve to argue for a model of fan genesis and preservation that links phases of fan deposition and incision to late Pleistocene sea level fluctuations and tectonic uplift. The authors forward the hypothesis that the presence of a paleo sea cliff (marine trimming) of the older fan makes this unit a reliable paleo-sea level marker and implies an average local site uplift rate for the coastline of ~2.5 mm/yr.

Having a longstanding interest in the tectonics and geomorphology of Crete and having visited the spectacular fan sequence at Domata Beach, we were very excited to read and provide comments on the manuscript by Mouslopoulou et al. We commend the authors on a nice study attempting to shed light on such an interesting deposit in southern Crete. However, we have several major concerns about the manuscript that we would like the authors to address. Our points of major concern are listed below. We have also included detailed line-by-line comments in an effort to help clarify and improve the study.

Sincerely,

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(1) Lack of a sedimentologic and stratigraphic descriptions of the Domata fan in the context of other alluvial fans on Crete in the current version of the manuscript.

The Klados River gorge itself is not unique, but one of five similar gorges that drain the Lefka Ori (White Mountains) and there is little difference in the coastal geomorphology at the mouths of each of these gorges. However, having visited this fan sequence and studied numerous other fans on Crete, we can say that the Klados (Domata) fan sequence is sedimentologically and stratigraphically unique among fan deposits on Crete. Most alluvial fans in Crete are coarse grained, clast supported, and weakly stratified. By contrast the Domata fan sequence is finer grained, having horizons that are variably clast and matrix supported, and better stratified than any other fan that we have seen on the island to date. It is these sedimentological details that will provide the most insight into the origins of the fan unit. The unique sedimentology and stratigraphy of this fan relative to other fans in Crete suggests that a different process is responsible for the deposition of this fan sequence. Given the short transport distance through the Klados River gorge (~ 5 km) and the relatively fine grained nature of the fan deposit, the Domata fan sequence is suggestive of a high-energy process. Stratigraphic and sedimentological descriptions of the fan sequence and discussion of how these observations compare with other studies of fans on Crete would substantially improve the manuscript. Based on the data presented current version of the manuscript it is difficult to evaluate whether or not the authors' argument that the fan sequence represents two fan. An alternative interpretation is that the Domata fan sequence represents a single depositional phase followed by unsteady incision, as is common in alluvial fill-cut terrace sequences (also known as complex-response fill terraces of Bull, 1990).

Importantly, our own observations indicate that the entire Domata fan sequence overlies a beach deposit that is the lateral continuation of the Holocene bioerosional notch (see figure below). If correct, such a stratigraphic relationship demands that the Domata fan sequence is Holocene, rather than Pleistocene, which is in direct challenge to the geochronology presented in this manuscript. Furthermore, we are curious as to why luminance dating was only attempted on a fan sequence that is almost entirely comprised of carbonate detritus? Why not also try to date the underlying beach deposit that contains more material suitable for luminance dating and is less likely to suffer from incomplete bleaching?

(2) The luminescence geochronology and the lack of tests for, or detailed discussion of the potential for and implications of incomplete bleaching.

The proper tests needed to confirm or reject whether or not incomplete bleaching has occurred were not reported. Without these key tests of samples from a depositional environment that is notorious for incomplete bleaching (Rhodes et al., 2010), it is difficult to interpret the luminescence data as being a trustworthy chronometer reflecting a true burial age.

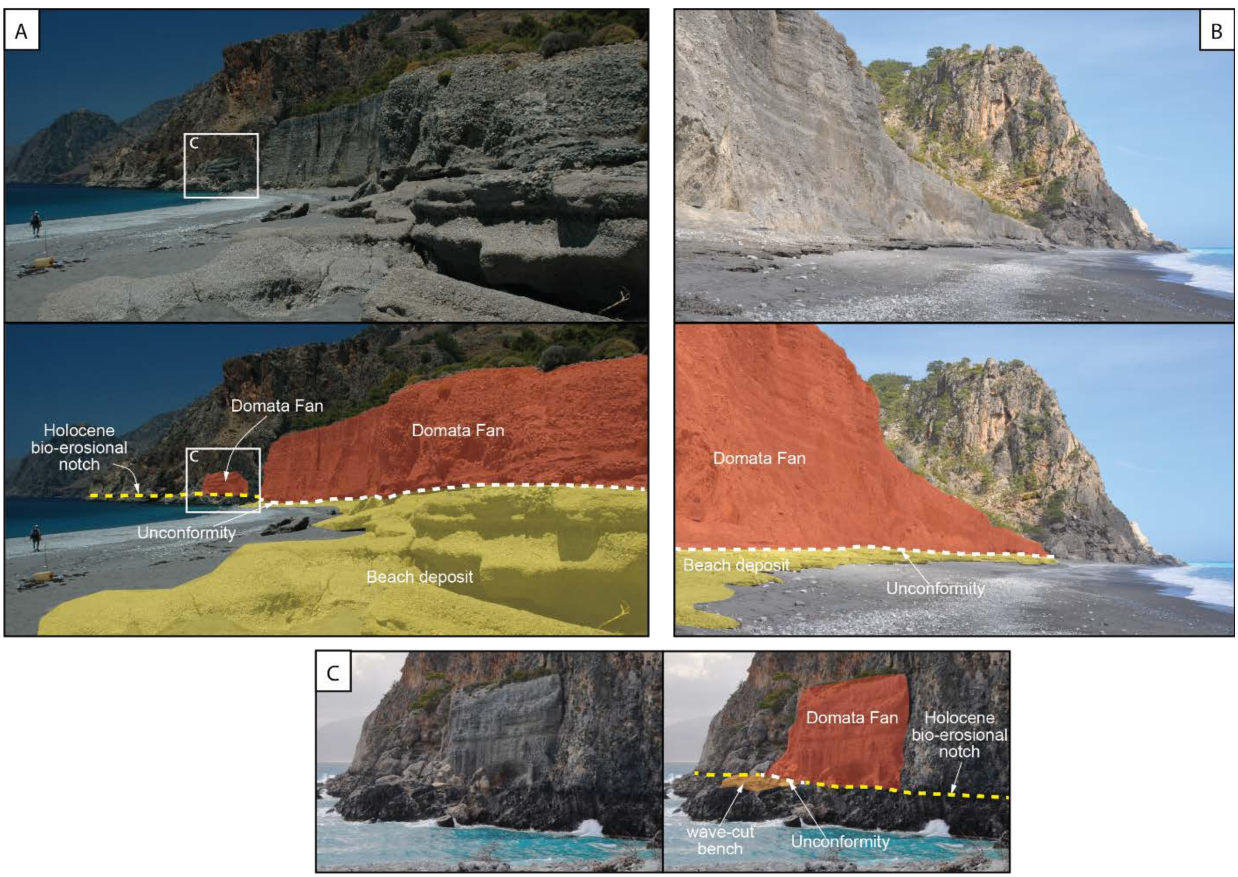
Every other study that has used luminescence dating to constrain the timing of alluvial fan deposition on Crete has successfully used quartz OSL (Pope et al., 2008; 2015; Gallen et al., 2014; Runnels et al., 2014). The fact that this method did not work for this study is of significance provided that the setting is geologically, tectonically and climatically similar to the locations of all of the aforementioned studies. The only thing that makes the Domata fan sequence unique in its sedimentology and stratigraphy, which suggests that a different process is responsible for its deposition (see comment above). Our suspicion is that the unique origin of the Domata fan sequence is why quartz OSL was unsuccessful. Furthermore, we question the reliability of the feldspar IRSL data without bleaching tests. It is acknowledged in the text that incomplete bleaching can explain the noisy IRSL data (P. 8, Lines 4-5), but the significance of this signal and the proper tests for incomplete bleaching are not present in the manuscript. Provided the unique problems with quartz OSL signals in this deposit, coupled with the known problems of incomplete bleaching in alluvial fans, and results that are difficult to explain, one is hard pressed to interpret this data at face value without prior proper vetting of the luminescence signals.

(3) Incomplete review of pertinent literature.

Much of the literature on 1) Cretan alluvial fans and 2) alternative models for the tectonics of the Hellenic forearc are missing from the manuscript. In addition to the excellent work of Pope et al. (2008), Pope et al. (2016), Runnels et al. (2014), and Gallen et al. (2014) employ luminescence geochronology to date alluvial fans on Crete. Pope et al. (2016) and Runnels et al. (2014) are absent from the current version of the manuscript. While Gallen et al. (2014) is cited, no acknowledgement is made for this studies contributions to understanding the Quaternary coastal stratigraphy of Crete. In addition to successfully dating alluvial fans with quartz OSL, the Gallen et al. (2014) study dates marine terrace deposits with OSL that are buried by alluvial fans. The authors of the above cited studies, and especially Gallen et al. (2014) use detailed mapping, stratigraphy and sedimentology of the deposits, pedology, OSL geochronology and a global sea level curve to derive a model for the coastal stratigraphy in southern Crete that relates interactions between tectonics, climate and eustacy. Discussion of the findings and interpretations presented by Mouslopoulou et al. in the context of other, similar studies from Crete would greatly improve the manuscript.

The review of the Quaternary tectonics of Crete is incomplete. In the background section and again in the discussion, alternative models for the Quaternary vertical tectonics of the island are not discussed. Section 2 reads as though consensus has been reached regarding “Late Quaternary uplift transients”. However, there is an ongoing scientific debate in the literature about whether or not these Late Quaternary uplift transients actually exist or if there are problems with the geochronology used to derive this model. While this may be the favored interpretation of the authors of this manuscript, other interpretations should be acknowledged and the ongoing controversy in the literature noted.

Supplemental Figure:



Supplemental figure: Photos and interpretations of the stratigraphy of the Domata fan sequence. (A) West-facing view of fan unit. Upper panel show original photo and lower panel shows interpreted stratigraphy. The fan unit overlies a beach deposit that is at the same elevation as a Holocene bio-erosion notch. The white box shows the location of C. (B) East-facing view of the fan unit. Upper panel show original photo and lower panel shows interpreted stratigraphy. (C) West facing view of a fan remnant overlying the Holocene notch and a wave-cut bench (see A for location). Left panel is original photo and right panel show the interpreted stratigraphy. Our interpretation is that the Domata fan sequence overlies a Holocene paleo-shoreline.

Line-by-line comments:

Introduction:

P. 2, Line 14-16: There is little mention of sediment supply here. The interplay between sediment supply and discharge is an important factor controlling alluvial fan deposition and may have little to do with changes in base level (e.g. rising sea-level). Furthermore, enhanced rainfall does not necessarily translate into alluvial fan deposition, as implied. Enhanced rainfall may favor increased discharge at the expense of reduced hillslope sediment supply because the hillslopes are vegetated more during times of increased annual precipitation and thus, the alluvial fan experiences an episode of incision. The interplay between climate and tectonics, deposition and incision is not straightforward.

We would also like to point the authors to alternative models for channel aggradation that might be relevant to this study. In particular, the recent work of Scherler et al. (2016) documents that Late Pleistocene fill terraces in southern California (a region climatically similar to Crete), which were traditionally interpreted as the result of climate change, are more likely the result of changes in sediment supply due to a large landslide in the catchment. This research is also relevant because they use luminance dating of the alluvial fill and discuss at length the geochronologic problems associated with incomplete bleaching.

P. 2, Line 20-24: These types of interpretations are difficult to discern from field data alone as the drivers of aggradation and incision reflect the interplay between sediment supply and discharge. What seems to be implied by this review is that deposition is driven solely by enhanced precipitation and incision by tectonic uplift. Yes, ultimately, the accommodation space needed for alluvial fan deposition is a result of tectonic processes, but at the time scale of the Late Pleistocene, the amount of tectonic uplift is insignificant in comparison to variations in climate-driven discharge and hillslope sediment supply from the mountainous catchment to the alluvial fan system. Furthermore, precipitation, temperature, and thus, vegetation co-vary in ways that make it difficult to predict how changes in precipitation relate to variations in catchment sediment supply and discharge. Depending on the climate and vegetative response, increased precipitation can lead to a reduction in sediment supply and incision, rather than aggradation.

The authors also appear unaware of a critical new body of research by Pope et al. (2016). In this paper, Pope and colleagues present 32 new OSL and U-series dates for what is undoubtedly the best dated alluvial fan sequence on the south coast of Crete, the Sfakia fan. Importantly, Pope et al. (2016) conclude that over the entirety of the late Quaternary, the Sfakia fan only experienced two episodes of entrenchment (incision), during the transition between Marine Isotope Stages (MIS) 5a/4 and MIS 2/1. They propose that the MIS 5a/4 period of fan incision was driven by sea level-induced base level fall; whereas the MIS 2/1 interval of incision (during a time of rapid eustatic sea level rise) was the result of reduced hillslope sediment supply to the fan resulting from landscape stabilization (re-vegetation) during the onset of the current interglacial (Holocene). If their data is correct – and they have lots of reliable geochronology to support their conclusions – the most recent episode of fan incision, for example had little if anything to do with base level fall or tectonic uplift. Pope and colleagues conclude that, with the exception of the above mentioned intervals of fan entrenchment (incision), fan aggradation occurred across the entire last interglacial/glacial cycle in all climatic settings (i.e. interglacials, interstadials, and stadials). The Domata fan is at the same latitude and only 25 km west of the Sfakia fan studied by Pope and colleagues (2016). It would be surprising if two nearby fan sequences on the south coast of Crete had markedly different aggradation-incision histories if the driving processes were climate change and/or eustatic variations, as both of these factors should almost certainly be nearly identical for the two sites. If there are real differences in the timing of fan aggradation and incision episodes between Domata and Sfakia they likely are the result of internal stochastic variations in catchment hillslope sediment supply to the channels feeding the alluvial fans.

P. 2, Line 26-29: It is an inference, based solely upon a morphogenetic interpretation of the topography of the Domata fan that the sequence represents two episodes of fan building as no stratigraphic evidence is provided. An alternative interpretation is that the Domata fan sequence represents a single depositional phase followed by unsteady incision, as is common in alluvial fill-cut terrace sequences (also known as complex-response fill terraces of Bull, 1990). For the former interpretation to be convincing, stratigraphic data delineating two distinct fan depositional units needs to be provided and would substantially improve the manuscript.

Geological setting of Crete and Vertical tectonics:

P. 3, Lines 18-24: We think that it is important to qualify these statements. The way that it is written herein is that there is scientific consensus on this topic, which is not the case. The debate is ongoing about uplift transients in the Hellenic forearc and it is important to acknowledge that this only presents one side of the argument. Many researchers favor a slow, mostly steady (at least at time scales greater than several earthquake events) Quaternary history of uplift for the island.

P. 3-4, Lines 32, 1-2: The Holocene notch is buried by the fan at Domata (see supporting data). Basic stratigraphic principles demand that if an extensive coastal geomorphic (geodetic) marker is locally buried by a sedimentary deposit, the deposit must by younger than the geomorphic marker, in this case the Holocene notch. This single field geomorphic observation places the geochronologic results and subsequent conclusions of this manuscript into doubt.

Data – methods – Chronology:

P. 4, Lines 4-5: This is an interpretation that requires supporting data. The morphology of the fan might equally well be represented by a single filling episode followed by unsteady incision into the fan deposit.

Coastal geomorphic features at Domata:

P. 4, lines 20-21: Where does the quartz and feldspar in the fan come from if the bedrock in the Klados River catchment is mostly carbonate?

P. 5, Lines 16-17: This is a key observation, but from figures 2-3 there is no evidence that the "lower fan" onlaps the "upper fan". The lower fan surface could simply be a fill-cut terrace into the maximum aggradational surface of the "upper fan". Please provide stratigraphic observations to support this interpretation.

P. 5, Line 23-24: It is difficult to see these details in Figure 6a. Is it possible to add some close-up photos of what the deposit looks like in detail with examples of the features provided? It would help readers' understanding of the stratigraphy if they could "see" what the fan deposit looks like. All of the overview photographs are great, but readers will be left wondering what the deposits looks like up close.

Also, what lithology makes up the fan deposits? We assume that it is carbonate, but no details are provided. If the deposit is mostly carbonate, where is the quartz and feldspar used for OSL coming from?

P. 5, Lines 23-25: Details on the stratigraphy for the "lower-fan" are great! How does the "upper-fan" stratigraphy differ? In other words, how does one distinguish between the lower and upper fan units as illustrated in figure 6b? These details are essential to the interpretation of two distinct fan units. Perhaps a composite stratigraphic column of the fan sequence would help.

P. 5, Lines 25-31: This is a key observation, but the level of detail in Figure 6 is insufficient for the reader to be able to see this relationship.

P. 5, Lines 33-34 & Page 6, Lines 1-2: From the way that this section of the text is written, it is unclear if the paleoshoreline (marine bench) is cut into, or buried by the fan. Our interpretation of Figure 6 is that it appear as though the paleoshoreline is buried by the fan. Our field observations from this area suggest that this Holocene shoreline is buried by the fan (see supporting figure).

P. 6, Line 10: Wegmann, (2008) and Gallen et al. (2014) also studied Pleistocene terraces on Crete and interpreted them in the context of stratigraphic relationships with interfingered alluvial fan deposits. Furthermore, Gallen et al. (2014) and Runnels et al. (2014) dated several alluvial fans in southern Crete with OSL, in addition to dating marine terraces with the same technique.

P. 6, Line 10-13: Based on stratigraphic relationships, pedology and OSL geochronology, Gallen et al., 2014 suggest a stratigraphic model for the genesis of marine terraces and alluvial fans based on tectonic, climatic and eustatic considerations in which marine abrasion platforms are cut and marine terrace deposits emplaced during eustatic transgressive-to-highstand phases , whereas Pleistocene alluvial fans are deposited during cooler (and drier) periods associated with relative sea-level low stands when sediment supply presumably is elevated relative to discharge. In addition to the geochronologic constraints on alluvial fan age, the other observation that implies deposition during cool periods is that the surface gradient of coastal alluvial fans on the south coast of are steep and prograde to a base level far lower than modern day sea level. This observation suggests that the Pleistocene fans are deposited when relative sea level is lower than the present day. This stratigraphic model is relevant because, if preservation potential were not a problem, a fan at lower elevation might be older than a marine terrace found at a high elevation relative to modern sea level.

OSL dating of alluvial fans:

P. 6, Line 13: Perhaps consider changing the heading of this section and all subsections. OSL stands for optically stimulated luminescence and IRSL stands for infra-red stimulated luminescence. They are different techniques and should be treated as such in the section headings. Similarly, figure 7 shows IRSL results, rather than OSL results as is indicated by the caption and the labels on the x-axis of the figures. Perhaps use "Luminescence dating of alluvial fans"?

P. 6, Line 14-21: The sampling strategy is well thought out; however, why are there no samples from the base of fan unit 2? Also what did the sampled horizons look like? The only information on this is for UF-2. Our field observations of this deposit suggest that it is composed primarily of carbonate sediment. Were there individual fine sand-to-silt lenses that were sampled, or simply stratigraphic horizons that were soft enough to hammer a tube into?

OSL results:

P. 7, Line 19-20: Gallen et al. (2014) and Runnels et al. (2014) also dated alluvial fans in southern Crete with Quartz OSL. There is also a new paper by Pope et al. (2016) that has an abundance of OSL data on the Sfakia fan sequence (see comment above).

P. 7, Line 19-27: This might be better reserved for the discussion, but what makes Domata unique in that quartz OSL of the fans there does not work? Quartz OSL has worked fine for multiple other studies where geologic conditions are similar (Pope et al., 2008, 2016; Gallen et al., 2014; Runnels et al., 2014).

P. 7, Line 29: What about the ages makes them reliable?

P. 8, Line 4-5: In alluvial fans, incomplete bleaching is a problem (e.g., Rhodes, 2010). It appears that the Domata fan samples suffer from incomplete bleaching. What tests, if any, were preformed to rule-out incomplete bleaching? For quartz OSL results that deviate from every other published study that has been performed on alluvial fans on Crete it is worth investigating why the signals are so different. Provided the short transport distance of the Klados River gorge (~ 5 km) and the high-energy nature of the Domata fan sequence, incomplete bleaching is potentially a major concern.

Taken at face value, the IRSL ages reported in Table 1 imply that the lower (supposedly younger) fan unit was emplaced before the end of deposition of the Upper (older) Fan unit. This is difficult to reconcile with the stratigraphic arguments advanced in this manuscript. Furthermore, the observation that the fan buries a presumably Holocene age paleoshoreline is problematic (see supplemental figure). Some experiments to test for incomplete bleaching or at least a detailed explanation of why incomplete bleaching isn't an issue should be added.

Soil development:

P. 8, Line 28-29: Were these colors derived from a Munsell color chart? If so, the hue, value and chroma values should be provided as they represent a semi-quantitative measure of color and several combinations of hue, value and chroma have the same color name. It would be useful to point out where the weak B horizon is on the Upper fan soil in figure 8C and the soil texture evidence used to support this interpretation. Having worked on soil profiles on Crete, and based on the photo presented in Fig. 8C, it looks like this profile could be characterized as a thin A horizon over a C horizon.

P. 8-9, Line 31-34, 1-4: Gallen (2013) provides detailed descriptions of alluvial fan soil profiles with OSL geochronology in Chapter 2. Gallen et al., 2014 and Runnels et al., 2014 describe the pedology of alluvial fans of Crete in conjunction with OSL geochronology. These studies should be discussed in the context of this study, as soils formed on alluvial fans of reportedly the same age are distinctly different. Furthermore, aside from color, observations supporting the notion that the soil profiles shown in figure 8B and C are consistent with the descriptions of stage 2C soils from Pope et al., 2008, particularly soil textures consistent with an increase in clay content (e.g. Bt horizon), are not provided. Based on observations presented in Gallen (2013) and Gallen et al. (2014), the soils on these fan surfaces are less mature than fans dated to ca. 40 ka that have evidence of pedogenic alteration to > 1.5 m below the present-day surface (see figure 4 of Gallen et al., 2014 and Appendix of Chapter 2 in Gallen, 2013).

P. 9, Line 11-13: This isn't supported by the geochronology (keep in mind the difference between OSL and IRSL). The data suggests that the alluvial fan units are synchronous. The Upper fan unit is bracketed between ~54 and 23 ka and the lower fan unit ceased deposition ~40-28 ka.

P. 9, Line 13-15: Aside from the problem that the geochronology suggests that the Upper fan surface was abandoned ~5-15 ka *after* the lower fan surface, is the Liar et al. (2009) reference relevant in this context? Liar et al. (2009) work on Holocene soils. This study, according to the authors is about Pleistocene soils. The effects of a 5 ka difference in geomorphic surface age for surfaces that are presumably an order of magnitude older than that would need to be shown. One would expect that soils forming on different aged surfaces would become more similar over time. For example, a 5 ka time gap for the initiation of soil formation might be negligible after a 30-40 ka shared history of soil development.

Landscape evolution at Domata:

P. 9, Line 29-30: Why would falling sea-level promote deposition?

P. 10, Line 10-11: Why does relatively high sea-level now promote deposition? What are "deteriorating climate conditions", what evidence is there to support them any why do they promote fan deposition?

P. 10, line 27-29: But isn't the fan burying this Holocene deposit (see supplemental figure)?

P. 9-11, Line 17 – 32, 1 – 34, 1-3: Provided that the geochronology is correct, any number of interpretations could be argued to be equally valid within the uncertainty of the data. For a given date the authors utilize either the mean or the median as preferred to provide an older or younger age estimate, respectively. Furthermore, taken at face value the data indicate that the upper fan surface was active until 25 ka. It isn't until lines 1-3 on page 11 that the reader is told that this sandy horizon is a fine-grained cap on the entire deposit. The position of the luminescence samples in a composite stratigraphy of the fan sequence is needed in order to understand the context of the data.

Another observation which should be addressed in the context of the stratigraphic model is how an unvegetated near-vertical cliff of unconsolidated gravel can remain between the Upper and Lower fan units for ~ 39 ka? Furthermore, why is the morphology of the cliffs on the Upper and Lower fan units so similar despite an inferred 35 kyr age difference (see figures 5 and 10 in manuscript)? When fault scarps are formed in unconsolidated alluvial fan sediments in places like the Basin and Range of the southwestern United States, they may initially be vertical geomorphic features, but through hillslope erosional processes, the morphology of the scarp changes through time (e.g. McCalpin, 1996). Diffusion of scarps through time has proven to be a useful relative dating tool in studies of both fault scarps (e.g. Nash, 1980) and paleo-shoreline scarps (e.g. Andrews and Bucknam, 1987). Perhaps this could be attempted in this study.

Why aren't similar fan deposits observed in the five gorges that drain southward off the Lefka Ori (White Mountains)? The Klados River gorge is the only one that preserves such spectacular fans. Despite the contention that Domata beach is geomorphically unique along the southwest coast of Crete, it is not. All the major gorge outlets to the ocean along the Lefka Ori are morphologically similar, yet none host similar fan deposits. Each gorge should preserve similar features if, as it is implied the forcing that generated the fans is a coupled climate-tectonic-eustasy signal that should affect the island regionally.

The importance of tectonic uplift at Domata:

P. 11 Line 17-18: Where is the marine terrace that cut this cliff? Based on the stratigraphic model, one world expect marine deposits between the two fans. An uncertainty analysis on the elevation of the inner shoreline and some evidence that this cliff corresponds with a marine abrasion platform would be beneficial for readers. Furthermore, if it is assumed that the base of the fan lies on a marine abrasion platform (e.g. marine terrace), the difference in age between the marine platform and the overlying alluvial fan can be substantial (see Gallen et al., 2014 for examples from southern Crete).

P. 11 Line 11-32: There is reason to suspect that Pleistocene radiocarbon ages might suffer from alteration of primary material, shifting radiocarbon dead ages to ones that are younger. This is nicely discussed by Wegmann, 2008 and can be noted in δO^{18} and δC^{13} shifted to more negative (terrestrial) values, relative to marine standards, in Triberti et al., 2014.

P. 12 Lines 1 – 15: Again, this is only the opinion of a few and does not represent the view of many other researchers that study the tectonic geomorphology of Crete. It would be useful to include a more thorough discussion of all the relevant literature.

P. 12, Line 17-20: No evidence is provided for the climatic link. The geochronology is simply not precise enough to permit such interpretations.

Conclusions:

P. 12, Line 25-26: This is an inference based on uncertain geochronology. Perhaps it is better to say “One interpretation of the data” rather than “Data analysis shows”.

P. 12, Line 28-29: It’s not entirely clear to us how this interpretation is supported by the data.

References cited in review that are not cited in the manuscript:

Andrews, D. J., and Bucknam, R. C., 1987, Fitting degradation of shoreline scarps by a nonlinear diffusion model: Journal of Geophysical Research: Solid Earth, v. 92, no. B12, p. 12857-12867.

Bull, W.B., 1990, Stream-terrace genesis: implications for soil development: Geomorphology, v. 3, p. 351-367.

Gallen, S.F., 2013. The Development of Topography in Ancient and Active Orogens: Case Studies of Landscape Evolution in the Southern Appalachians, USA and Crete, Greece. Ph.D. Dissertation, North Carolina State University, Raleigh, NC, 171 pp.

McCalpin, J., 1996, Paleoseismology: San Diego, Academic Press, p. 583.

Nash, D. B., 1980, Morphologic Dating of Degraded Normal Fault Scarps: The Journal of Geology, v. 88, no. 3, p. 353-360.

Pope, R.J.J., Candy, I., and Skourtsos, E., 2016, A chronology of alluvial fan response to Late Quaternary sea level and climate change, Crete: Quaternary Research, v. 86, p. 170-183.

Rhodes, E.J., 2011. Optically Stimulated Luminescence Dating of Sediments over the Past 200,000 Years, *Ann. Rev. Earth planet Sci.*, **39,** 461-488, doi:10.1146/annurev-earth-040610-133425.

Runnels, C., DiGregorio, C., Wegmann, K.W., Gallen, S.F., Strasser, T.F., and Panagopoulou, E., 2014, Lower Palaeolithic artifacts from Plakias, Crete: Implications for Hominin Dispersals: Eurasian Prehistory, v. 11, p. 129-152.

Scherler, D., Lamb, M. P., Rhodes, E. J., and Avouac, J.-P., 2016, Climate-change versus landslide origin of fill terraces in a rapidly eroding bedrock landscape: San Gabriel River, California: Geological Society of America Bulletin.

Wegmann, K.W., 2008. Tectonic geomorphology above Mediterranean subduction zones; northern Apennines of Italy and Crete, Greece, Ph.D. Dissertation, Lehigh University, Bethlehem, PA, 169 pp.