

Response to the new short-comment by S. Gallen & K. Wegmann

Below, we respond again briefly to the additional comments of Gallen. For a more detailed answer, please refer to our first response, dated January 27th, 2017.

1. **Lack of sedimentologic and stratigraphic context:** This is not true. The stratigraphy, and the stratigraphic context of the major geomorphic features described in this work, is the major tool that we use to support our main observations. We copy and paste here text from our first response: *'Our primary interest in our work on Crete is to help constrain its late Quaternary tectonic development. With this work we aim to use first order geomorphic features and stratigraphic relationships to understand the late Quaternary vertical deformation of western Crete. In doing so, we recognised the importance of the Domata fan sequence and the important marine bench cut in upper fan at Domata. This feature allows us to independently derive a Late Quaternary uplift rate from this section of western Crete. The paper is important because of this independence from previously derived uplift rates on western Crete (e.g., Shaw et al., 2008; Strasser et al., 2011; Tiberti et al., 2014; Mouslopoulou et al., 2015 – all references included in the submitted version). To achieve these objectives, we needed to understand the first order fan geomorphology and from it dissect out the sequence of events required in landscape evolution. We derived a basic sequence of events that is demanded by the stratigraphic relationships present at Domata and present these in the paper. We have gone to some effort to place the Domata fan sequence within its stratigraphic and chronologic context so that we fully understand the uplift rate derived. The final piece of the puzzle required to derive our uplift rate was its integration with a high quality sea level curve for the last 125 kyr. We chose Siddall et al.'s (2003) sea level curve because of its precision, relative proximity to the Mediterranean, yet its isolation from the variable tectonic signatures and isostatic problems associated with glacial loading of that region, and for its similarity with the Lisiecki & Raymo (2005) stacked curve. The luminescence dating we undertook simply provides confirmation of the chronological framework for the events that we had deduced with reasonable confidence from other stratigraphic and geomorphic observations. We completely agree with Gallen & Wegmann that our IRSL dating, with its large uncertainties, cannot provide adequate resolution to separate the individual events presented here. Similarly, the soil descriptions provide a supporting understanding for our stratigraphic conclusions, independently confirming that the two fans are built over distinct time-periods. In our revised version we explain more clearly these objectives and the evidence for our interpretation of the sequence of events in our 'landscape evolution' at Domata, so that there can be no misunderstanding'.*

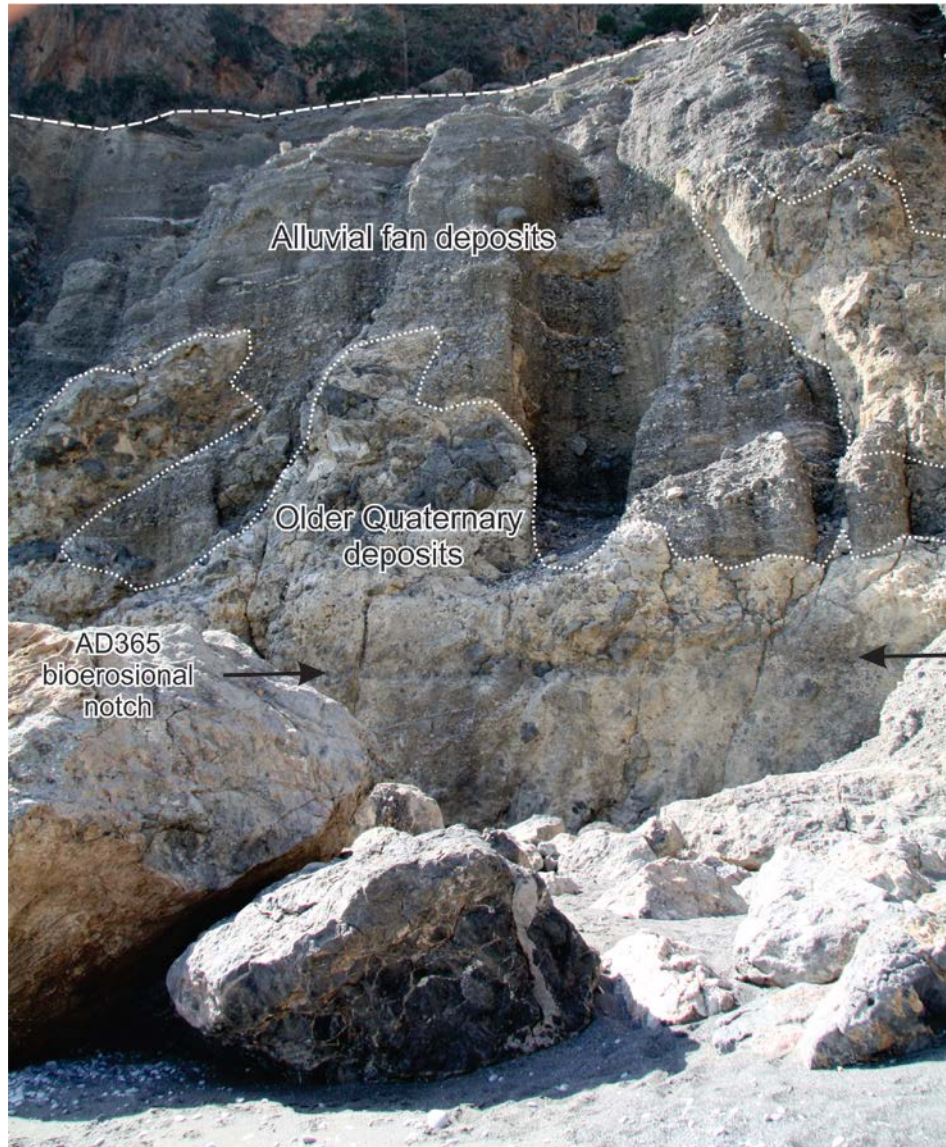
And we continue (regarding the sedimentological context): *'This objective does not include a comprehensive description of the materials of the Domata fans and their developmental chronology, as has been undertaken for other fans of southern Crete by others (e.g., Nemeč & Postma, 1993; Gallen et al., 2014; Pope et al., 2008, 2016). Neither is the objective to compare Domata fan stratigraphy with that of other alluvial fan systems on Crete. We welcome the prospect of additional work that would enhance insight into the processes of fan deposition and a refined chronology that may help better understand relationships between sediment transfer rates and climate in this area.'*

2. **The beach underlying the fan sequence and the 365AD paleo-shoreline:** We repeat that we do not agree with the correlations proposed by Gallen and Wegmann between the surface on the beach deposits, the "wave cut bench" and the AD365 bioerosional notch. The bedrock "wave-cut bench" underlying fan deposits at the west-end of Domata beach shown

in their supplementary figure may locally be at the same elevation as the AD365 notch, but there is no genetic linkage between that bioerosional notch and the “wave-cut bench”. At the west-end of the beach, east of the red area highlighted in Gallen & Wegmann’s supplementary figure (c), fan deposits sit on a deeply dissected and weathered surface that lies above the AD365 bioerosional notch. This relationship is illustrated and confirmed in the Figure that we provide below, in this response letter, and which we intend to include in the revised version of the manuscript as Figure 6c. If the deposits at the east-end of the beach indeed represent beach deposits (we have limited data on these materials), they may represent shoreface deposits of the marine trimming event. This information is entirely consistent with our interpretation as it stands.

3. **The age of the Domata fan sequence:** Gallen and Wegmann’s interpretations are based largely on their correlation of the beach deposits with the AD365 bioerosional notch and their inference that the fan deposits are therefore Holocene in age. Our response to this correlation is discussed above, and our interpretation is corroborated independently by the relative scales of the Sfakia fan and its catchment and those of the Klados catchment and the Domata fans. Despite the contrasting catchment sizes, the area covered by Holocene materials at the Sfakia fan is insignificant compared with the size of the Domata fan deposits. The Sfakia fan Holocene materials rise to a maximum elevation of c. 40 m, while those of the Domata fan rise to close to 100 m. Even under the most extreme local conditions, this incongruence points to an age older than Holocene for the Domata fan deposits. In addition, interpretation of the Domata materials as Holocene in age would contradict our geochronological data. In addition, and further reinforcing our interpretation, the resultant uplift rates conform with previously published rates (including Gallen’s) derived independently in areas nearby and on central-eastern Crete. These three strands of independent data, each support our interpretation of a last glacial age for the Domata fan deposits. By far the most rational option is to accept the age constraints provided by the geochronological data, as we do in our paper.
4. **Soil development:** We never stated that we did not perform a proper description of the soils. This statement is from the two commentators who obviously consider macroscopic observations ‘improper’. In our previous response, we put significant effort to address all the soil-related comments posed by the two commentators. And while we state openly, in both the submitted manuscript and our response to their comments, that our observations are mainly macroscopic, these macroscopic observations completely support our independent conclusion (based on geomorphic evidence) that the soil in the upper fan is better developed, and thus more mature, compared to the soil of the lower fan. How these macroscopic observations support this conclusion, is explained in our previous response to Gallen & Wegmann and we encourage whoever interested to look at pages 8-9-10 of the uploaded file (27 Jan 2017). It is also explained in the corresponding section (3.3) of the submitted and revised version.

To summarise, we agree that there is additional work that could and should be done at Domata to help answer Gallen & Wegmann’s questions and others as well. In this paper, we are reporting specifically on an investigation that provided interesting results that constrain the late Quaternary vertical deformation of western Crete. In our view, and in the view of the other reviewers, this manuscript achieves this objective.



Annotated image illustrating the relationship between the unconformity at the base of the fan sequence and the AD365 bioerosional notch. This picture is taken between the location illustrated by Gallen & Wegmann’s (first comment) in his supplementary figure (c) and the mouth of the Klados River. Our interpretation of the stratigraphy is as follows: a dissected erosional surface on older Quaternary sediments pre-dates the fan deposits, while the AD365 bioerosional notch post-dates both the surface and the fan deposits that rest on it. In other words, the coincidence of the “wave-cut bench” and the AD365 bioerosional notch which Gallen & Wegmann illustrate in their supplementary figures cannot mean that the entire Domata fan deposits are Holocene in age. Here it is evident that the unconformity does not represent the same feature as the AD365 bioerosional notch. This Figure will be included in our revised manuscript as Figure 6c.