**Climate
of the Past**
Discussions

Interactive comment on "Extreme flood events reconstruction during the last century in the El Bibane lagoon (Southeast of Tunisia): A Multi-proxy Approach" *by* A. Affouri et al.

Anonymous Referee #4

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General comments

The paper focuses on the study of historical paleofloods from a high-resolution geochemical and sedimentological analysis of a sediment core from El Bibane Lagoon (Southern Tunisia). The paper deals with two main objectives: to identify the main sediment sources within the Tataouine and Mednine watershed areas and to decipher El Bibane lagoon sediment record in order to evidence some historical flood events.

The first part -concerning the sedimentological and geochemical characterization of potential sediment sources from the lagoon watershed -is rather convincing even if the approach remain very classical and not innovative. The second part - related to the analyse of the sediment core from El Bibane Lagoon - successfully evidences that

some fine-grained and Fe and Ti-enriched layers are likely related to historical major flood episodes according to the absolute dating of the core. Once again, the approach is fine even if rather classical, since it demonstrates the potential use of the proposed multi-proxy approach in order to identify paleoflood events in sedimentary sequences.

In general, the objectives mentioned above are somehow reached by the proposed work, but the relationship between these two objectives is not clearly demonstrated in the paper as it is written. Furthermore, these objectives are not clearly stated in the manuscript. Finally, the relationship between these two parts is not further discussed in the manuscript. The main results from the first part need to be thoughtfully used when discussing the sediment record. These particular points need to be improved before publication.

The proposed multi-proxy approach (sedimentology, elemental chemistry, statistical analysis) is adequate. Nevertheless, some major points need to be improved since the interpretations are not fully demonstrated nor convincing as they are presented: for instance, the complete description of the methods should be addressed carefully, the significance of results, including error and limit should be discussed thoughtfully.

Specific comments

Some re-organisation/modifications are recommended in order to improve the manuscript: - Section 2, p4 lines 4-25, these paragraphs may be moved to p3 line 13 - Section 4, move the sentence p5 lines 22-24 to the end of the paragraph p6 line 8 - Section 4, p6 lines 3-4: I guess that the samples from the watershed area were selected before sampling in order to characterize the main potential sediment suppliers to the lagoon. As it is written, it seems that the samples were chosen arbitrarily. I suggest to replace the sentence: "In order to characterize main sources, these surface sediments were subdivided into four regions as:" by " The main potential sediment sources were sampled in order to characterize their sedimentological and chemical signatures as follow: - three samples from the beach area (S1, S2 and S3) representing

the marine source, ten samples (S7 to S16) from Fessi Oued catchment representing the fluvial/river sources, two dune samples (S17 and S18) representing the eolian component. Moreover, three surface samples (S4 to S6) from El Bibane lagoon have been selected to represent present-day sedimentation. - Section 4, Analytical Methods are not properly described. Some important information are missing: o The sediment core lithological description should be detailed, organic-rich clay (mentioned p10 line 2) are mentioned but not shown; o The XRF method should be detailed (apparatus, sample size for discrete surface sediment, error, standard deviation, etc.); o Calibration of XRF data and conversion as percentages; o Grain-size analysis: size/volume of analysed samples, main parameters of the measurements, duration of the measure, reproducibility, error, effect of ultrasound on carbonate shells, etc. - Section 4, Statistical analyses: o The whole method should be discussed, including input and output parameters, pre-treatment of data, etc. o Explain why the grain-size parameters were not included in the dataset for PCA? - Section 5, Results, 5.1.1 sediment description. The results should be given properly: o The grain-size parameters should include the mode, median, sorting (when unimodal); o The main sediment class should be mentioned (clay, cohesive silt, sortable silt, sand); o The photos and observations from figure 5 should be described in much more detailed since they could serve as discriminant (for instance the S17 and S18 observations are rather different, explain why?; the eolian particles as quartz are known to have peculiar morphology); o The significance of variations range should be discussed. The clay fraction varies between 1 and 2% (Figure 9). What about the significance of such a variation? o The results from samples S4 to S6 shown in figure 6 are not discussed within the main text? o The differences between samples S7 and S10 should be emphasized (4 modes for S7 on figure 6 and the coarsest mode for S10 being smaller than 100 μm according to figure 6, the fine fraction seems over-represented for sample S18, etc.); o The sorting of samples S17 and S18 should be calculated since it appears to be discriminant in term of eolian source. - Section 5, Results, 5.1.2 Distribution of major and trace elements: o The matrix effect (carbonate vs. quartz) should be major: are there any CaCO3 mea-

surements? It would help to evaluate this matrix effect; o p8 lines 17 to 20, the authors described the behaviour of iron: "The iron displays its highest percentages in the Fessi River samples. Lower values characterize the eolian dunes whereas this element is totally absent in marine sediments. This same distribution is also observed for Ti, K and Al...". According to figure 7, I do not agree with this sentence: Fe is indeed maximum in samples from the Fessi River but more generally Fe content is highest in samples from the Mednine and Tataouine catchment areas and from Fessi River. Ti is also highest in samples from Mednine and Tataouine watershed areas, but not in samples from the Fessi River itself (figure 7), whereas K and Al are only higher in samples from the continent compared with marine samples. o p9 lines 4 and 5: Sr concentrations are obviously lower than Ca concentrations! This is not new! o p9 lines 9 to 12, the authors write "these results corroborate the marine origin..." but this is not correct. The samples are marine samples, and the fact that Ca content is high is only consistent with that fact that samples are marine samples with a dominant biogenic component. o p9 lines 13 to 15, this sentence appears to be rather obvious: Si is a major component of alumina-silicate (obviously as silicate) and of quartz (which is pure SiO2); only the eolian samples are characterized by high values, so Si enrichment could be used as a diagnostic for eolian provenance; - Section 5: o 5.2 core description (p9 and 10), this section should rather appear in the material section 4.1; o The description of the grain-size variations is absolutely not sufficient. A complete description (including mode, median, sorting, clay fraction, silt fraction, sand fraction, etc.) should appear (with a dedicated paragraph), as this is absolutely essential for identifying potential paleoflood events! I do not understand why these results do not appear in this section; o The complete description of XRF data (with a dedicated paragraph) should also be included! o The chronological aspect should be discussed before the sedimentological and geochemical results (§5.3 should appear as §5.2.1) : o 5.3 dating: I would like the authors to discuss the impact of major flood events on the sedimentation rate; o I suggest some modification as follow: âĂć §5.2.1 Pb and Cs dating âĂć §5.2.2 grain size/sedimentological results âĂć §5.2.3 XRF results - Section 6, §6.1 PCA o This

paragraph should be included in the result section (§5.1.3 Principal Component Analysis) and should not appear in the discussion o Explain why the PCA does not include grain-size data? o Is this reference adequate? (p11 line 4, Windston et al., 1989) o p11 lines 11-13, "The first component represents therefore the fine fraction od the sediment, which is mainly composed of various types of clay minerals, usually abundant in surface sediments"; this conclusion is not supported by the dataset since the grain-size analyses are not included in the PCA. To my opinion Factor 1 is mainly related to the matrix which is either calcium dominated or alumina-silicate dominated, in other words, Factor 1 depends on nature of the sediment: carbonate (i.e. biogenic component in this particular case) or alumina-silicate (i.e. detrital or terrigenous component); o p11 lines 16-17, the following conclusion "These two factors differentiate hence carbonates and both sand and clay sediments" is once again not fully supported by the PCA analyses since grain-size is not taken into account in the PCA. Actually, the fact that Zr (and Si) likely drives Factor 2 suggests that grain-size should be one forcing factor. I suggest the author to check this conclusion by including grain-size analyses in the PCA input; o I do agree with the conclusion that 1) Ca and Sr may be used to retrace the marine component, 2) Al, Fe, Ti and K may be used to retrace riverine supply and 3) Zr and Si may be used to retrace the eolian contribution, but I am not fully convinced that PCA is useful to demonstrate this commonly accepted statement. - §6 Discussion o The choice of the parameters should be better justified, for instance explain the fact that Zr is not further used? o p12 lines 3-4, Ti/Ca and Fe/Ca ratio appear to reflect solely the marine component. I suggest to use "supply" or "contribution" or "component" instead of "pole" since the paper is not dealing with end-members; o p12 lines 4-9, this part of the discussion is a bit clumsy. It is clear from Figure 12 that these ratios are efficient in discriminating the "continental source" (in this case the eolian source) and "marine source" and the text mentions that "El Bibane lagoon surface sediments are situated between marine and continental sources". But, according to Figure 12, the sediments from El Bibane are in fact situated between the Marine and Fluvial sources, while the pure "eolian" contribution is likely not significant. o §6.3: in this paragraph, it

C5

is not clear if the paleoflood sequences were first identified thanks to their lithological aspects, or if they were identified using both grain-size and elemental ratio? This point should be clarified; o p12 lines 13-14: the sentence "...high content of the clay and silt and high content of the elemental ratio" should be replaced by "...high content in silt and high elemental ratio..." o p13 lines 20-25: the hypothesis of multi-phased flooding is not supported by the data (see figure 13); - Conclusion o p14 lines 4-6: please add "sedimentological and geochemical characterization", change "in order to reconstruct" by "in order to identify the specific signature of paleoflood events"; o p14 lines 10-11: change "...are situated between marine and continental end members" by "are situated between marine and river sources". o p14 line 12, the term "clay" should be omitted since it only represents <2 % of the sediment.

Technical corrections

The English spelling and grammar should be checked carefully.

Please check the consistency of some terms, for instance "Mednine" or "Medenine" should be used consistently throughout the text and figures.

Some sentences/wording are not correct: - p1 line 18: "high content of the clay and silt" is not correct, replaced by "high content in clay and silt" - p1 line 19 (and within the main text): "high content of the elemental ratio" is not appropriate; transform to "high elemental ratio" - p3 line 21: "Tyrrhenian" should be explained (it is explained on page 4, but should be explained on its first appearance) - p4 line 7: Matmata is missing on figure 2 - p5 line 4: change "the number of sunny days may reach 64,4%" by "the number of sunny days may reach 64%" - p5 lines 4-5 : "The rainfall . . . annual average that does not exceed 200 mm". This average should be drawn on Figure 3; - etc.. . .

Some of the references (from the references list) are not used within the text: - Prospero et al., 1981 - Raji, 1984 - Torres-Padron et al., 2002

Some references are not correctly used within the main text: - p2 lines 15-16: Becker

C6

et al., 1989 should be replaced by Becker, 1989 - p2 line 20: Noren, 2002 should be replaced by Noren et al., 2002 - p2 lines 22-23: Liu et al., 1993 should be replaced by Liu & Fearn, 1992 - p2 line 23: Donnelly et al., 2007 should be replaced by Donelly and Woodruff, 2007 - p3 line 20: Medhioub, 1981 should be replaced by Medhioub & Perthuist, 1981 - p4 line 3: Pilkey et al., 1989 should be replaced by Pilkey, 1989 - p4 line 2: Bouougri, 2012 should be replaced by Bouougri & Parada, 2012

Figures: - Figures 2 and 4 could be gathered in a unique figure; the bottom insert in figure 4 could be removed; - Figure 2: the reference Ben Haj Ali et al., 1985 is missing in the references list, check the colour variations between Neogene and Paleogene, and between Permian and Permo-Trias; - Figure 3: I suggest to use only diagram, reference is missing; - Figures 7 and 8, I suggest to use distinct symbols for eolian (diamond), marine (square) and river samples; - Figure 9: add some parameters (mode, median, etc.) and specify the considered grain-size fraction (sortable silt, cohesive silt, fine sand or give the size range <63μm, >63μm, etc.); - Figure 13 could be associated with Figure 9. Explain the difference between Figure 13(b) and figure 3? Figure 3 could thus be removed.