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Interactive comment on "Extreme marine events revealed by lagoonal sedimentary records in Ghar el Melh during the last 2500 years in the northeast of Tunisia" *by* Balkis Samah Kohila et al.

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The authors would like to thank the Anonymous Referee #1 for his valuable comments and suggestions, they will be seriously taking into consideration and corresponding corrections will be made in the next version of the manuscript. However, we present some clarification and answers (R) to his questions (Q) in the following text : Settings : Q1 :The setting lacks of basic information such as: the lithology of the bedrock surrounding the lagoon and forming the Medjerda river catchment; the Medjerda water and solid discharges (average and during floods); the amplitude of local tides and the existence of long-shore littoral currents; present wave heights and sea surge during

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severe storms. R1 : We will take into consideration your comment and we will reformulate this paragraph in the next version as following : This lagoon is directly limited in the north side by a mountain range called “Jbel Nadhour” (325 m). This mountain is composed of a marine Pliocene material (Figure 1) represented by sandstone sediments. The lagoon is bordered in the west and south side by recent quaternary marshy grounds formed by clay and silt sediments. While in the eastern side, it is separated from the sea by a sandy barrier, with a local opening (El Boughaz) allowing a permanent hydraulic communication (Oueslati et al., 2006). This sandy barrier was formed by a littoral drift oriented from the North-East to the South-West. Over time, the delta of Medjerda was distinguished by a high flood peak and a high interannual discharge variability. The Medjerda water storage shows 22% of the country’s renewable water resources. This river’s average sediment yield is about 10 g/l and it is characterized by an annual average flow of 30 m3/s and reached 3500 m3/s in the exceptional flood of March 1973 where solid discharge reached 100 g/l. In the Gulf of Tunis, the mean amplitude of semi-diurnal micro-tidal activities measures between 12 and 30 cm (El Arrim, 1996; Saïdi et al., 2012). According to Oueslati, 1993, the amplitude of the tidal range in this region was estimated of around 35 cm. The coastal environment of Gulf of Tunis was exposed to natural erosion processes provoked by waves, tides, and periodic storm surges. This erosion is also due to the impact of the longshore coastal drift from the SE to NW direction. Methods : Q2 : There is no indication of the method adopted for coring GEM3 and GEM4 (“piston core” is very general, e.g.: were they manually-operated? Which was the diameter of the core?) and for the collection of surface samples. Concerning these latter, no information is provided on how shallow they were (few centimetres? Few decimeters?), their geomorphological position in the landscape (river bed? Floodplain? Beach? Dunes? Etc.) and if they were collected from present-day soil horizons (meaning they may be slightly weathered sediment). No indication is provided on the grain-size classification applied. R2 : We will take into consideration your comment and we will reformulate this paragraph in the next version as following : Two piston cores were manually collected in 2012 in the Northeast of Ghar el Melh lagoon. These cores are 126 cm (GEM4) and 98 cm (GEM3) in length and 10 cm in diameter (Figure 1). They were manually sampled according a transect East West into the lagoon (âĹij200m from the sandy barrier for GEM3 and âĹij400m for GEM4). 29 surface sediment samples of around 20 to 30g were collected from present-day soil horizons from the Medejerda watershed to the littoral area (beaches and dunes). The particle sizes obtained are classified according to Folk and Ward (1957) into three categories (clay $\Phi < 2\mu$m, silt 2μm $<\Phi < 63\mu$m and sand $\Phi > 63\mu$m). Q3 : Calibration of 14C ages Inaccuracy inherent to radiocarbon dating is not expressed in Table 1 and 2. Probability of the calibrated ages as 1 or 2 sigma is not reported. Altogether, these errors are not discussed when integrating the 210Pb and 137Cs chronologies and estimating sedimentation rates. This raises concerns on the effective existence of the hypothesized time-correlations between the datasets and the Bond events.

R3 : We will take into consideration your comment. Table 1 N° Labo code Mollusk used Depth (cm) δ13C (‰ 14C ages (BP) 14C ages (Cal AD) (One Sigma ranges) [Start: end] 1 Sac A 42679 Cerastoderma glaucum 42 -0.8 565±30 [cal AD 1692: cal AD 1765] 2 Sac A 42685 Cerastoderma glaucum 54 1.5 930±30 [cal AD 1399: cal AD 1451] 3 Sac A 42683 Cerastoderma glaucum 60 0.2 1195±30 [cal AD 1186: cal AD 1260] 4 Sac A 42681 Cerastoderma glaucum 70 0.2 1535±30 [cal AD 811: cal AD 902] 5 Sac A 42680 Cerastoderma glaucum 76 1.4 1830±30 [cal AD 550: cal AD 630] 6 Sac A 42686 Cerastoderma glaucum 80 0.6 2015±30 [cal AD 332: cal AD 424] 7 Sac A 42684 Cerastoderma glaucum 88 -1.1 2350±30 [cal BC 67: cal AD 33] 8 Sac A 42682 Cerastoderma glaucum 93 -1.4 2490±30 [cal BC 267: cal BC 144]

Table 2 N° Labo code Mollusk used Depth (cm) δ13C (‰ 14C ages (BP) 14C ages (Cal AD) (One Sigma ranges) [Start: end] 1 Sac A 42676 Cerastoderma glaucum 40 -3.7 490±30 [cal AD 1807: cal AD 1906] 2 Sac A 42675 Cerastoderma glaucum 45 1.8 615±30 [cal AD 1652: cal AD 1712] 3 Sac A 42673 Cerastoderma glaucum 55 0.3 1181±30 [cal AD 786: cal AD 1344] 4 Sac A 42672 Cerastoderma glaucum 72 -2.9 2545±30 [cal BC 332: cal BC 225] 5 Sac A 42674 Cerastoderma glaucum 85 -4.3

2660±30 [cal BC 431: cal BC 353] 6 Sac A 42678 Cerastoderma glaucum 101 -6.6 2625±30 [cal BC 399: cal BC 339]a 7 Sac A 42677 Cerastoderma glaucum 110 -4.8 2725±30 [cal BC 512: cal BC 400] aAge inversion Table 3 Labo code 210Pb age (AD) 14C year (BP) Tree-ring 14C age (BP) IntCall 13 Reservoir age R(t) (year) Model age Marine 04 ïĄĎ R (year) Sac A 44506 1845 450±30 114±8 336 488±23 -38±20

R : In order to determine a mean value to be used with marine calibration curves, more studies are needed and our ΔR should be taken with prudence. The eight and seven shells collected respectively from GEM3 and GEM4 cores were calibrated using the oxcal 4 program with a ΔR value of -38 ± 20 years. The results are described in Tables 1 and 2 with an error range of 1σ. For the GEM4 core, we note that sample n°6 must be a remobilized material from older sediments since sample n°7 taken from a lower sedimentary level has a younger age. R : In order to determine the ΔR, these errors of 14C were discussed when integrating the 210Pb and 137Cs chronologies and the comparison was done.

Discussion and conclusions : Q : A prominent conceptual inadequacy is the apparent nonconsideration by the authors of the so-called Walther's Law (Walther, 1894). This basic law of stratigraphy states that any vertical progression of facies is the result of a succession of depositional environments that are laterally juxtlaposed to each other (Lopez, 2015, in Encyclopedia of Scientific Dating Methods). This implies that changes in the lithofacies characteristics and grain-size distribution in the two cored locations may be autocyclic, due to, e.g., the migration of the barrier islands, shifting of tidal inlets and channels, progradation of lagoonal deltas. Vertical changes in sediment characteristics can thus occur without the intervention of "extreme" climatic events. This depotentiates the conclusions of the authors, that appear not fully supported by the data. It further shows that alternative interpretations should be considered. R : In the next version, we will try to reformulate this discussion and append a paragraph Âń 5.1. Site sensitivity to overwash deposits Âż. We will try also to integrate more references and hypotheses. Generally and from a geological point of view, I totally agree with you about the importance of Walther's law especially in stratigraphy. But in our case, we have a vertical facies formed by fine sediments interbedded by just two sandy layers. The presence of sand layers and a discontinuity contact is interpreted as a result of intense overwash events. Through the study of the GEM3 and the GEM4 cores, our objective was to identify marine submersion deposits in a general way, through their geochemical and sedimentological characteristics, without making a distinction between storm and tsunami deposits. The entrance of marine sandy materials into the lagoon cannot be explained by a migration of the barrier islands. Indeed, we could imaginate that on this time scale (2000 years), the displacement of the sandy barrier is progressive with the increase of sea level. In this case, our sedimentary archives should have presented a gradual increase in the percentage of marine sand towards more recent periods. This is not observed. The observation of two discrete sandy deposits can only be explained by two exceptional events. . The same deduction can also be used regarding the progradation of the Medjerda delta. This process is also progressive and we should have seen a progressive trend in the evolution of our facies. This is also not observed. We interpret our marine sand deposits with a sharp contact at their base by exceptional events and not by progressive processes.

Q : Poor English language recurrently hinders the comprehension of the concepts presented in the text. R : The English will be revised by a native.

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