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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Estimation of successive co-seismic vertical offsets using coeval sedimentary events – application to the Sea of Marmara's Central Basin (North Anatolian Fault)" *by* C. Beck et al.

Anonymous Referee #2

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General comments: The manuscript focus in: 1. Applying many sedimentological analyses for identifying homogenite+turbidite deposits (HmTu) in Cinarcik and Central Basins. Several HmTu are dated for the Holocene in Cinarcik Basin (MD01-2425) and in the inner Central Basin (MD01-2429). Two of these deposits are correlated in both basins. 2. Identified an interval of 2,000 years immediately beneath the lacustrine to marine transition in the lacustrine strata. Only one radiocarbon age was obtained for this interval on top of fault scarp in the inner Central Basin. 3. Based on high-resolution subbotom profiles and sediment analyses (shown on the manuscript

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are core x-rays and physical properties) they identify 11 HmTu units on top of the fault scarp to the south of the Central Basin "inner basin", and at $\sim$ 8 km away near the northern edge of the "inner basin" close to some faults. 4. They assume that these HmTu were deposited as a result of earthquakes and based on the thickness difference between the two sites they estimated a vertical component of co-seismic uplift and a paleomagnitude for the earthquakes. There are many assumptions in this paper that are not supported by the data presented. NHEES is a journal of natural hazards and this paper if published could be misleading for hazard evaluations.

Specific comments: 1. The correlation between Cinarcik and Central Basins for the Holocene, although not the main focus of the paper, is good and it would have been good for the authors to correlate these events to historic ruptures. There are several papers that have conducted these correlations. Some of the first ones published were by Polonia et al., 2004 and McHugh et al., 2006. Both papers focus on developing tools for submarine paleoseismology in Marmara Sea and should be cited in the Introduction. 2. The correlation between the core on top of the scarp and that at the northern edge of the Central Basin inner basin is not strong. McHugh et al., 2014 studied three cores in the inner Central Basin and identified twenty-one events in the past 6,000 years. They found that the best-preserved record and thickest deposits were in the deepest part of the basin or so called "depocenter". The core recovered at the edge of the basin and near the fault scarp lacked the required stratal continuity for one-to-one correlation. McHugh et al., 2014 also presented evidence for erosion in the three cores. This implies that the thickness of a deposit and hemipelagic layer in between the HmTu units is not always complete. Both the HmTu and hemipelagic sediment in between can be influenced by many variables such as erosion of the sediment by subsequent event, possible contributions from an adjacent basin ruptures reaching one part of the basin but not the scarp, etc. So thickness can be a rather variable marker even in a small area such as the 'inner basin". I disagree that the events have been precisely correlated as stated on the abstract. 3. A much stronger case could be presented with radiocarbon ages obtained in the 2000 year studied interval. If this were to be

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accomplished the stratal correlations between the top of the scarp and edge of the basin could be verified. As presented, they are not strong. Another possibility that the authors should consider would be to match the thicknesses in the marine interval where foraminifers can be used for dating as demonstrated in many papers such as Drab et al., 2012. Once the correlation between the top of scarp and edge of the basin is established based on a chronology in the marine part of the record, then the older lacustrine part of the stratigraphy could be proposed more convincingly. 4. The authors show the magnetic susceptibility signal as a means for identification of events and for correlation between basins. The authors note that there are only a few thin HmTu for the Holocene part of the record. But, the magnetic susceptibility signal is an indication of the magnetic character of the sediments and can be influenced by several variables including the presence of magnetic minerals, grain size, and diagenesis. In the case of the marine Holocene record, a decrease of the magnetic susceptibility signal below ∼3 to 5 m as shown on Figure 3 could be due to iron oxide reduction and pyrite precipitation in relation to the sulphate methane reaction zone as proposed by ÇaÄ§atay et al., 2012 and Drab et al., 2012 (or PhD thesis). It is not clear from the text if the authors based their evaluation of a "few, thin HmTu" for the Holocene on these data or grain size data. It is important to note that Holocene HmTu in the studied basins have a low relative proportion of sand and a much higher relative proportion of silt and clay (e.g., ÇaÄ§atay et al., 2012). 5. I agree with the authors that a vertical, dip component has been documented for the NAF but the lateral component should not be ignored (it is a strike slip boundary). Further, the tilting of strata towards the NAF is very well documented on high-resolution subbottom profiles in Izmit Gulf (Cormier et al., 2006) and MCS lines in Cincarcik and Tekirdag Basins (e.g., Seeber et al., 2006). It is not that well expressed on the high-resolution subbottom profiles shown across Central Basin (Figure 4b). The subbottom reflections with depth show more of a "u-shape" towards the center of the basin. The thickening is towards the center of the basin, and thinning towards the edges of the inner basin, rather than thickening towards the fault as expected with a dip component. 6. I would be hesitant in making estimates

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about paleomagnitudes based on thickness correlations and fault slip with the data presented. Also the link between the sedimentary events and precise rupturing site is not clearly demonstrated. Neither is the assumption that all ruptures occurred within an 8 or 5 km length. They should show evidence about the length of the fault if they are going to use 8 km. Their age correlations for Central Basin and Cinarcik for the Holocene marine part suggest that ruptures extended in both these basins. Larger than 8 km. 7. Some minor issues: the vertical scale on Figure 2 should be in meters. There is a discrepancy in the core depths between Line 158 and Figure 4. Please add Polonia et al., 2004 and McHugh et al., 2006 on Line 67. ÇaÄ§atay et al., 2009 and McHugh et al., 2008 on Line 78. Add Seeber et al., 2006, Kurt et al., 2013 on Line 97.

Although not the main focus of the paper, it has good points such as the correlation of events between Cinarcik and Central Basins. This is important in as far as understanding historic ruptures for seismic risk assessment and the data presented is good. Expanding on this part could be very useful. For the inner Central Basin, a much stronger case is needed for the reconstruction of earthquake-induced sedimentary events and fault slip for the 2000-year interval if this paper were to be published. I agree with the authors that higher resolution analyses of the sediments are required for the Holocene part of the record, but also for the pre-Holocene. This could be a very good and innovative paper for Marmara Sea if Holocene and pre-Holocene studied parts were strengthened. But in my view it should not be published until these issues are addressed.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 4069, 2014.