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Earth Surface Dynamics Discussions

Interactive comment on "Dating and morphostratigraphy of uplifted marine terraces in the Makran subduction zone (Iran)" *by* Raphaël Normand et al.

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This work studies the exceptional exposure of marine terraces along the Makran coast in Iran. This is a quite interesting study that attempt to integrate previous chronological constraints on these terraces with novel ages based on multiple approaches (OSL/14C/U/Th); in addition, the authors use detailed mapping and morphometry to estimate the patterns of surface deformation in this area, then used to discuss the source and mechanisms of such deformation in the context of the Makran subduction zone. The authors do a good work attempting to join the different ages obtained, which in some cases are not easy to interpret. One of the controversial points is the

presence of MIS 3 terraces, which are apparently related to localized high uplift rates. The presence of MIS 3 terraces is rare, but they discuss all the pros and cons for this interpretation. I personally find the paper clearly written with some minor typos and some issues; however, in general they clearly explain the logical steps behind their interpretations, which is the good way to do science (e.g. Section 5.2). The quality of the figures and the fashion used to display the distribution of the terraces are excellent and quite original, also the final interpretation about the possible mechanisms of tilting are nicely explained in the corresponding figure.

My main critics comes from:

1) The authors refer to active structures (Section 5.2 and 5.3.1) to explain local variations in uplift rates but the description or reference to these structures are poor, most of them based on speculative faults not observed on the field or mapped by other authors, then this part of the discussion becomes light and not convincing it all, specially about the kinematics of these structures. I must highlight that in general long wavelength deformation patterns are usually associated to deeper sources of deformation, such as the subduction megathrust, instead short wavelength deformation patterns are usually associated to shallower sources of deformation like crustal faults, I think that framing the interpretations based on these concepts may provide a more convincing discussion on the sources of deformation (e.g. asperities or subducted seamounts are related to deeper sources of deformation, instead abnormal local high uplift rates could be related to crustal faults, etc.., this would also help to complement section 5.3.2).

2) In sections 5.3.2 and 5.3.3 the authors discuss the deformation patterns and uplift rates of marine terraces in the context of the subduction earthquake cycle, I am aware that the historical records of earthquakes are scarce but I feel that the topics or paradigms mentioned in the introduction are weakly resolved, so I find their final interpretations and discussion a bit frustrating not fulfilling the expectation introduced at the beginning of the manuscript.

Minor/moderate comments:

Page 2 Line 28: “ten sequences”? Or ten levels of marine terraces?

Page 3 Line 27: “different tomographical properties”? this is ambiguous, what they describe in the tomography?

Page 4 Line 2: slope sedimentary rocks? Do you mean Sedimentary rocks of slope depositional environment?

Page 4 line 7: omega shaped?

Page 5, line 27: “TanDEM-X (0.4 arcsec/∼12m ….” This is repeated in page 2, there are also several other repetitions along the text

Page 7, line 13: “OSL dating”, as I understood, you tried with quartz but then decided to use IRSL technique in feldspars, maybe is better state IRSL dating method instead of OSL, here and along the text as the results presented comes from IRSL.

Page 8, line 15: “nearest sea-level highstand” and also refer Jara-Muñoz et al., 2015. This is not correct it all, usually we use the age of the immediately preceding sea-level highstand, as the deposits are accumulated during the sea-level drop that follows the higstand.

Page 8, line 25: the author use equations to estimate the minimum and maximum uplift rate, why do not propagate the errors like have been classically done by other authors before? (e.g Gallen et al., 2014)

Page 9, line 18: The concept of eroded shoreline angle sounds weird, and also the way to estimate its elevation, is not clear which part is used to estimate the elevation of this feature, as the paleo-platform can extend seawards for long distances its elevation can display wide variations.

Page 9, line 21: “their altitude might underestimate the reality”? do you mean their altitude might represent minimum estimate?

Page 9, line 24: “… we calculated uplift rates for each sample…” but before you mention that uplift rates are not calculated using the sample elevation but the shoreline angles, this is contradictory.

Page 9, line 25: this is contradictory, here it says “… we subtracted the sediment thickness observed on the field…” and in line 29 it says “… we subtracted a general value for the thickness of the sediments...” so, what you really did?

Page 10, line 11: “results of radiometric. . ...” this definitely is not the best way to start a paragraph, please use topic sentences here and in some other paragraphs of the manuscript. Page 11, line 26: remove “mostly”

Page 14, line 5: “The observation of normal faulting in a convergence context is intriguing”. Actually this is very common in the fore arc of the Andes where normal fault are a result of crustal bending and several other processes, not suggesting subsidence (e.g. Lowless et al., 2010; Melnick et al., 2012; Melnick et al., 2009).

Page 15, line 9: “Those few terraces that are not tilted. …. Might provide insights on the uplift component directly linked to subduction dynamics. . ..” I disagree, as mentioned in the major comments is the pattern of deformation which may provide insight about the mechanisms of deformation either long or short wavelength may provide insights about deeper or shallower sources related to crustal structures or megathrust deformation.

Finally, I must say that this is an interesting paper with high potential to be a great contribution after improving and correcting some of the issues described before.

References:

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