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# *Interactive comment on* "Biostratigraphic evidence of dramatic Holocene uplift of Robinson Crusoe Island, Juan Fernández Ridge, SE Pacific Ocean" *by* P. Sepúlveda et al.

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We would like to thank detailed and positive comments by the referee. His comments are followed by our response:

1) The paper rules out flexural loading of islands at a suitable distance (causing a flexural bulge) as the cause for uplift. Instead suggests post-collapse/erosional isostatic rebound, which is a possible and plausible explanation for the uplift. However, the authors cannot rule out intrusions at the base of the edifice (without surface volcanism) as another possible cause for uplift, as it has been proposed for other archipelagos, e.g.



A. Klügel, T. Hansteen, and K. Galipp. Earth and Planetary Science Letters, 236(1-2):211–226, 2005. J. Madeira, J. Mata, C. Mourão, A. Brum da Silveira, S. Martins, R. Ramalho, and D. Hoffmann. Journal of Volcanology and Geothermal Research, 196(3-4):219–235, 2010. R. S. Ramalho, G. Helffrich, M. Cosca, D. Vance, D. Hoffmann, and D. N. Schmidt.Nature Geoscience, 3(11):774–777, 2010. R. S. Ramalho, G. Helffrich, M. Cosca, D. Vance, D. Hoffmann, and D. N. Schmidt. Marine Geology, 275:84–95, 2010. R. S. Ramalho, G. Helffrich, D. N. Schmidt, and D. Vance. Journal of the Geological Society, 167(3):519–538, 2010.

As such, the paper would become richer if this possibility was discussed and eventually admitted/rejected. However, from the evidence provided/discussed in the paper, I don't think the authors can entirely rule out this mechanism.

R: In fact we rule out the flexural bulge caused by surface loading because the plausible sources seem to be too far and/or small to be significant. However we agree with the reviewer that intrusion at the base of the edifice without volcanism cannot be ruled out. We do not have any proof to accept or reject this mechanism beyond the reasonable doubt imposed by the older age of the post-erosional volcanism, which is here ca. 1 Ma with no further evidence of active magmatism in a setting defined by very rapid eastward displacement of the Nazca Plate. As a consequence we will add this theoretical possibility with two selected references to back it up.

2) A look at the surrounding bathymetry is important to independently test the uplift, since 70 m of uplift in the last âĹij8 ka would inevitably dislocate the insular shelf edge (formed approximately at -130 m during the Last Glacial Maximum) upwards by approximately the same amount of vertical displacement. The shelf edge should be at about -60 m, if uplift of 70 m occurred within the last 8 ka.

R: This is a very relevant remark because our evidence of uplift (based on a sedimentary marine-transitional sequence with ca. 8 ka marine shells) is only present in the western part of the island. In addition, the more recent shelf break is partially visible

in the bathymetry at ca. 80-90 m depth in the southern part of the island (but deeper at more than 150m on the opposite side), which suggests that uplift is localized and essentially asymmetric. For this reason we favored a local but still significant source (in terms of volume) that may have triggered an asymmetric flexural response, which could be a massive landslide as observed at other oceanic islands (e.g., McMurty et al., 2004). In fact, our modeling, after Smith and Wessel (2000,) indicates that ca. 70 m of localized uplift could be produced with a giant mass wasting, which is possible based on the morphology of the island, although there is no direct evidence for a related deposit, arguably because of the low resolution bathymetry available there. We will add a short sentence to emphasize that special situation.

3) Iwo Jima has similar uplift rates, if not higher - however the source is quite different (inflation of a volcanic dome).

R: Iwo Jima is a special case with a shallow and localized source of deformation. However, we can rule out this mechanism because of the absence of geological evidence of volcanic activity during the last 1 My. In fact, a possible eruption was mentioned in 1835 (Suctliffe, 1839 cited by Ch. Darwin) but in a separate contribution we will offer both geological and historical arguments against this possibility.

Technical/minor comments to the text:

1) Lines 19-22 - propose to complete the existing sentence to the following: As the plate moves away from the melting source due to sea-floor spreading, these volcanoes are extinguished and new volcanic edifices arise over the active hotspot, forming linear, age-progressive island chains such as the Hawaiian-Emperor seamount chain.

R: The suggestion makes the idea clearer; the sentence will be modified accordingly.

2) lines 26 – 4 "Uplift and subsidence, as earlier noted by Charles Darwin in the 19th century, mostly respond to the growth of the underlying swell and the related isostatic rebound." This sentence is too simplistic in its view - needs revision. In addition to



hotspot swell growth and post-erosional isostatic rebound, uplift has also been explained by flexural bulge effects resulting from loading of nearby islands; changes of density in the mantle; and intrusions at the base of the edifice. Subsidence is mostly due to flexural loading and ageing/cooling of the lithosphere (processes unknown to Darwin in the early 19th Century).

R: We agree with the reviewer; there are other processes that explain uplift and subsidence at oceanic islands. Our intention was actually to give some credit to the first one that recognized these vertical movements. We will modify this sentence in order to emphasize the merit of Darwin regarding his observation of the vertical displacement, with a separate remark on the processes known at present to be possible drivers.

3) page 13612, lines 21-22 "The dramatic Holocene uplift of RCI cannot be explained as a flexural response to the loading exerted by the active hotspot." The hotspot does not exert surface loading - the edifices created at the hotspot do. The expression should thus be corrected. Also, unless new islands/seamounts were being created in the last 8000 years - which is not the case - this hypothesis was already very implausible.

R: We agree with the reviewer; the sentence is vague and will be corrected accordingly. In fact, there is no evidence of Holocene activity along the JFR, at least in the emerged lands and the volume of the youngest component of the chain is not enough for a flexural response at RCI.

4) same page, lines 26-27 "The bathymetry in fact seems to indicate relative subsidence of this part of the oceanic crust." How can the authors know this? The lack of a bulge does not mean subsidence – just lack of uplift by inflation of the surrounding seafloor? Besides, the authors have no age constraints when looking at the bathymetry - and the reported uplift concerns the last 8 ka.

R: We are referring to the long-wave bathymetric anomaly in which the RCI is embedded. However, the reviewer is right, such an anomaly could be older than the reported uplift so there is no a contradiction between them. We will modify the sentence as

follows: ‘The bathymetry in fact shows a negative anomaly in this part of the oceanic crust’.

5) same page, lines 27-29 "General subsidence could occur in the wake of a mantle plume migrating away from a particular area, as this part of the crust would no longer be sustained by it, combined with the load (...) The word "crust" should be substituted by "lithosphere". Dynamic uplift/subsidence is impinged at the base of the lithosphere, not the crust.

R: We agree with the reviewer; we will replace ‘crust’ for ‘lithosphere’ as a more precise term.

6) page 13613, lines 15-17 "The two islands might have been separated during a large-scale landslide event (or events), which in turn may have caused isostatic rebound." Further evidence for this should be found using a bathymetric map with medium resolution, if available.

R: We agree with the reviewer; unfortunately there is no higher resolution bathymetry for this part of the island.

7) There are 2 references that are mentioned in the text but are not in the reference list: Watts and Ten Brink (1989); Ramalho et al., (2010).

R: Our mistake; corrected.

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