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Comment on se-2021-61

Nathan Bangs (Referee)

Referee comment on "Marine forearc structure of eastern Java and its role in the 1994 Java tsunami earthquake" by Yueyang Xia et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-61-RC1, 2021

This paper presents a newly reprocessed seismic reflection profile across the Java margin to show a subducted seamount and make the case that this seamount has a role in controlling slip distribution/behavior during the 1994 Java tsunami earthquake. The paper is well written and straightforward. The reprocessing has been effective and the new image is quite good. It provides a solid basis for the interpretation. Overall, I have few comments about the writing and the presentation. I have outlined my main concerns below.

The reprocessed seismic profile (image and velocities) is convincing in showing the subducted seamount, splay faults, and backthrust, i.e. the major structural elements involved in the processes discussed in the paper. Along with the gravity and bathymetry, the paper makes a good case for the subducted seamount. Unfortunately, the gain is low in Figure 2 and the profile is very long. Consequently, it is shrunk way down and makes it hard to see much detail. Even the enlargements in Figure 3 are very faint. It is also puzzling why magnetics data was not used to further support this interpretation (I presume it exists), but the seamount is reasonably well established.

The main concern I have with the paper is that the structures that this paper associates with the seamount and invoked to explain the changes in slip behavior are not unique to seamounts and their role here is not well tied to the seamount. Splay faults and backthrusts are very common in settings without seamounts, so the fact that they are seen on the profile is not evidence that they formed due to the seamount as is stated in the abstract (Line 15) and discussion (Line 184). With just one profile, and one that appears to be on the very far flank of the seamount (at least on the flank of the bathymetric and gravity highs), it is hard to tell how the structures and properties (Vp; Line 185) claimed to be associated with the seamount (Line 195; the profile is not well positioned to support this statement) are associated with it, or even anomalous relative to the margin as a whole. Are these structures and properties typical along this margin in areas that are not subducting seamounts? Did they form during this seamount subduction or were they pre-existing, possibly even developed from an earlier subducted seamount? ……..

Even if these structures (splay faults and backthrusts) are a result of the seamount, are they currently active in recent earthquakes or tsunami earthquakes? Their existence does not mean they have been active recently. Do any of these thrusts offset recent slope cover strata? Are there thrust ridges on the seafloor extending along strike? Is there evidence that this transect is currently more active than regions away from the seamount? And, even if these faults have been recently active, they may not have slipped during the 1994 event as presumed here (Line 233-234). As the rupture model in Figure 1 shows, slip is downdip from the seamount and splay faults may not be involved in coseismic slip. They may slip aseismically during the interseismic period. The scenario presented here is certainly possible and intriguing, but establishing any link between the seamount, upper plate structures and slip along any specific fault in a recent earthquake is a high bar to reach and requires more data to establish very convincingly.

Finally, the discussion on splay faults, subducted seamounts and tsunami magnitudes (lines 233-242) is extremely speculative. The stresses related to the seamount, the relative strengths of the faults inferred from reflection amplitudes, shears stresses along faults, etc. are not constrained well enough to make this kind of assessment. The scenario involving splay faults that the authors describe is possible without a seamount (there is no seamount involved in the Nankai case referenced: Moore et al., 2007; Line 245). The question is whether the seamount is enhancing this process somehow, yet there is no evidence presented that it has.

Overall, I have mixed feeling about this paper as it is. It presents good data and shows a subducting seamount well. There are a number of possibilities presented that are certainly plausible and interesting to think about, but there is not a great deal of evidence that ties these structures and processes directly to the seamount. My recommendation is inclusion of other nearby data if at all possible (either bathymetry or any existing seismic lines) to show a better connection between the seamount and current deformation that can be attributed to the seamount and distinctly different from the margin without a seamount. If that is not possible, then it needs revision to consider a broader range of possibilities for the development of these structures and their role in recent slip behavior.