

Review of 'Subducting Structure in Central Cascadia from Margin-Crossing Seismic Tomography'.

Summary: Thank you for your thoughtful and constructive reviews, which have substantially improved this manuscript. The major points you raised were: (1) the size and wave speeds of the proposed seamounts appeared unrealistic and required improved resolution tests; and (2) the comparisons between our model results and previous studies needed to be strengthened. In response, we have rerun our inversion using an improved starting model and conducted new synthetic resolution tests with 1 km tall anomalies. These additions demonstrate that our approach can reliably resolve seamount structures with more realistic dimensions. We have also significantly expanded the discussion comparing our model features with those reported in prior studies. We added a series of horizontal slices from our tomographic model (Figure 5) to better illustrate the lateral extent of Siletzia and the associated mafic dike complex. We also added Supplementary Figure S1 to help quantify the extent of Siletzia more systematically.

Below, we provide our responses (in red) to each of the reviewers' comments (in black). The portions of the text that are directly from the manuscript are italicized.

Review A - Bassett:

This manuscript integrates new and legacy onshore-offshore and ocean-bottom seismic data to provide new 3-D constraints on the seismic velocity structure and crustal structure of the central Cascadia subduction zone. The study region is notable for being characterized by lower plate coupling relative to adjacent segments, and may have acted as a barrier during past great earthquakes. The results reveal spatial variability in velocities within the forearc, which are attributed to geological terrain distributions, and the presence of mafic dykes and faults. The subducting plate is shown to exhibit variability in Moho depth and circular high-velocity anomalies interpreted as subducting seamounts are linked to scars at the deformation front.

The geometry of the crustal backstop, the geological terrain distribution in the overthrusting plate and the geometry, roughness and sediment cover of the subducting plate have all been shown to exert influence on the dimensions, slip behavior and segmentation of subduction zones. This study makes a timely, significant and valuable contribution by providing 3D constraints on several of these properties for an intriguing segment of the Cascadia subduction zone. The data and observations presented in this study will have implications for the quantification of seismic and tsunami hazard along the Cascadia subduction zone.

This study represents an important step in the analysis and integration of recent seismological datasets collected in Cascadia, and I believe it will be of wide interest to the readers of Seismica.

Below, I include a number of minor comments and suggestions for the authors to consider. I would like to emphasize that none of these should be viewed as show-stoppers, and they are simply suggestions for the authors consideration. I have thoroughly enjoyed reading and reviewing this manuscript and feel that considering these comments, alongside those of the other reviewers, should certainly see this manuscript approach a state worthy of publication in Seismica.

Comments and corrections:

- Line 4 – perhaps adjust this line so it's explicit your referring to the Moho of the subducting Juan de Fuca plate, and not the overthrusting plate.

We changed the wording to clarify that we are referring to the Moho of the subducting plate.

- Line 43 – “Cascadia megathrust earthquake” – perhaps include large or great so readers don't confuse this with a megathrust earthquake of any magnitude.

We made this modification.

- Line 111-112 – its intriguing that some seamounts correspond to gravity high's while other correspond to gravity lows. Is this due to differences in the presence/preservation of intrusive core's, or is there some other explanation?

We are using the gravity anomalies from Trehu et al. (2012). In this paper, they suggest the seamount eroded the upper plate forming the basin which causes it to show up as a gravity low.

- Lines 135-136 – minor tweak but for clarity it might be worth commenting on how the crust you associate with Pg refers to both the overthrusting and subducting plate, Pn samples the mantle of the Juan de Fuca plate and PmP reflects of the Moho of the Juan de Fuca plate.

We made this clarification.

- Line 185 – Label these lines on Fig 3.

We added labels for CASIE lines PS01, PS03, D14, PD15, PD14, PD14A, PD13 and PD12.

- Line 199 – Did you experiment with flattening the data based on the synthetic arrivals? In addition to the basins you mention, this can be very helpful when interpreting data that traverses regions with large topographic relief.

Yes, we picked some arrivals after flattening data based on synthetic arrivals through the starting model.

- Line 212 – How much of the uncertainty do you attribute to the tracer? It might be useful to give the readers some indication for how you think the uncertainty is apportioned. The component related to source and receiver locations, for example, must be very small.

We assume almost all of the uncertainty is in the travel time pick rather than related to the source/receiver locations or the ray tracer.

- Line 219-220 – Would it be possible to improve your starting model by incorporating the stacking velocity data derived from the processing of CASIE MCS data? These data would provide useful constraints on near surface wavespeeds, which may improve deeper imaging by preventing differences in shallow wavespeeds beneath the shots from being smeared along the raypaths. See Section 3.2 and Fig 7 of Bassett et al., JGR 2025 if you interested in how this has been done within 3-D onshore-offshore models at Hikurangi.

We opted not to use a 3D starting model made from the CASIE MCS data because the MCS data only provides 2D coverage and would leave large parts of our starting model a poor fit to the data.

- Section 4 – In addition to using the DWS to mask unsampled regions, would it be possible to include some plots of ray density?

We opt to show DWS instead of ray density as this factors in the contribution of the raypath to the slowness derivative at each node.

- Line 257-258 – In Fig 5 it looks like the 5.5 km/sec extends a very close to the deformation front. Does this imply that the Siletz Terrane actually extends this far offshore, or is an artifact of the wavespeed contours becoming subparallel to the slab above the top of the Juan de Fuca plate? Since you have a 3D model another way you could try and illustrate the extent of the Siletz Terrane is to calculate the thickness of material overlying the slab using a particular Vp threshold. You could then mark the updip extent of the terrane where 2 or 3 km of this material is present to account for the deflection of iso-velocity contours. Using 5.5 or 6 km/sec could do a good job of this. Just a suggestion.

You are correct that the Siletz terrane does not extend to the deformation front. To address this comment, we added Supplementary S1 showing the thickness of material greater than 5.5 km/s above our inferred top of crust. We added the following text to section 4.1.1: *“The Vp structure of the overriding plate reveals several distinct velocity anomalies. In the eastern part of our model, we identify a high-velocity body with values exceeding 5 km/s (Ashraf et al., 2025). Based on both its location and velocity characteristics, we interpret this feature as the Siletz terrane. Previous work shows that velocities within Siletzia vary spatially (Gedom et al., 2000), with an average of about 5.5 km/s in south-central Cascadia (Ashraf et al., 2025). In the outer forearc, overlapping velocities make it difficult to distinguish Siletzia from the downgoing plate. To address this, we use the combined pattern of velocity and thickness, together with the structural boundary inferred from aeromagnetic data. Supplementary Figure S1 shows the thickness of material between the 5.5 km/s isovelocity surface and the inferred top of the crust, located 6 km above the final Moho. Regions containing more than 3 km of material with >5.5 km/s above the inferred top of the subducting crust align most closely with the seaward edge of Siletzia mapped by Wells et al. (2014). The imperfect correspondence between this thickness-based boundary and the magnetic boundary suggests lateral variations in terrane thickness. Accordingly, in Figures 6–7, we use the 5.5 km/s contour, restricted to regions where it overlies more than 3 km of material with $V_p \geq 5.5$ km/s, to approximate the limit of the terrane boundary (Watt and Brothers, 2021).”*

- Section 4.1.3 – A good way of illustrating these velocity variations could be to include a second column in Fig 6 also showing each slice normalised against the average 1D Vp structure, or the average Vp gradient between the seafloor and Moho of the Juan de Fuca plate.

We chose not to include normalized velocity slices because Vp varies strongly with both depth and location across the study area. Normalization to an average 1D structure or to an average crustal gradient would therefore reduce meaningful lateral contrasts and obscure the structures of interest near the plate interface and within the overriding plate. Presenting absolute velocity slices more clearly highlights the spatial variations we discuss throughout the paper.

- Section 4.2 – Is the variability in Moho depth consistent with the slab geometry resolved from MCS data by Carbotte et al., or, do the Moho depth variation imply differences in crustal thickness.

To address this, we added a panel to Supplementary Figure S3 showing the difference between our Moho and the Top of Crust model from Carbotte et al., 2024 shifted down 6 km to approximate the Moho. We describe the similarities and differences between this surface, the Trehu et al. (2023) Moho interface and our final interface in section 4.2.

- Line 298 – In Figure 7 do you think it looks like there is another low Vp anomaly aligned and up-dip of S3 and S4?

Yes, it looks like there is a low Vp anomaly updip of S3 that we discuss in 4.1.3. Potentially this is the result of fluids being released and/or a damage zone associated with the ACF or seamount.

- Section 4.4 – I like the hypothesis based resolution tests. If you have also conducted checkerboard resolution test, these would be a good addition to the supplement.

We chose to focus on hypothesis-based resolution tests because they provide a more direct and interpretable evaluation of the model's ability to recover geologically realistic structures, which was the main objective of our analysis. Checkerboard tests, while informative for assessing spatial resolution in a general sense, can be less representative of the actual resolving power for the types of anomalies investigated here.

- Line 390-391 – Is this also similar to the relationships observed between subducting seamounts and earthquakes a north Hikurangi (e.g. Todd et al., 2018; Arai et al., 2020, Chesley et al., 2023)?

Yes, previous papers similarly show seismicity, and tremor is located down dip of the seamount defined by seismic imaging and typically above the plate interface (Todd et al., 2018, Arai et al., 2020, Shaddox & Schwartz, 2019). Chesley et al., 2021 primarily appears to image the resistive core of the seamount which is offset slightly from the highest point of the seismically defined seamount placing the seismicity slightly updip of this resistive core of the seamount. We added the following sentence to the manuscript: *"The spatial relationship between the seismicity and the imaged seamount, together with the associated focal mechanisms, is consistent with seismicity linked to seamount subduction along the central Ecuadorian margin (Segovia et al., 2018). Similar spatial patterns are observed along the northern Hikurangi margin (Shaddox and Schwartz, 2019; Arai et al., 2020; Todd et al., 2018), where seismicity and tremor are concentrated downdip of subducting seamounts along the plate boundary and within the overriding plate."*

- Line 396-397 – Do you think the seamount itself is intrinsically low-density, or if you subtracted the gravity effect of the basin would you end up with a gravity high?

We suspect the seamount is high density and Trehu et al. (2012) suggest a seamount in this region may have formed the basin which produces an overall free-air gravity low.

- Line 433 – "An analysis" – perhaps just expand on this so we know what type of analysis.

We changed this sentence to: *"Geochemical analyses combined with thermal models for the region suggest the source of the water is located at or near the megathrust..."*

- Line 438-439 – Thanks, but Bassett and Watts, 2015 is probably better than our 2025 review paper for the roughness/creep story.

We changed the reference to Bassett and Watts, 2015.

Figure comments:

Figure 2 – Consider placing ellipses around proposed seamounts. This would help correlation between the gravity and magnetic data – I found it particularly difficult identifying the magnetic anomalies associated with the seamounts.

We have implemented this change.

Figure 3 – Suggest adding the labels to the lines (at least for the CASIE dataset) so the reader can follow the text in 2.3 that refers to specific lines. It may also be worth expanding this figure to the full page width to help the squeeze the labels in.

We added labels for CASIE lines and increased the size of the figure.

Figure 4 – The offset and travel-time labels are quite small.

We made the labels larger on this figure.

Really nice work and paper – I enjoyed reading it very much! Dan Bassett

Review B - Suzanne Carbotte:

This is an interesting contribution presenting results from a new 3D Vp model for an ~150 km length of the offshore Cascadia Subduction zone. Observations from 4 different shoreline crossing OBS-seismometer studies conducted over the past several decades are synthesized and inverted to produce a new velocity model for the upper and lower plates. The velocity model provides constraints on the Vp structure of the Siletz terrane in this region thought to serve as crystalline static backstop for wedge accretion in the region, and a local high Vp zone interpreted as a mafic dike zone associated with Yachats basalt emplacement. It also shows WNW trending anomalies along the Alvin Canyon fault and changes in Moho depth consistent with the fault cutting both plates. 8 local quasi-circular high Vp anomalies at the approximate top crust surface are identified that the authors interpret as seamounts. The analysis approach follows that documented and applied by the senior authors in prior studies. Sensitivity studies are presented to evaluate ability of the data ray coverage to resolve the seamount anomalies and the spatial coincidence with other geophysical indicators of possible seamounts in these locations lend support to their presence.

Below I list my primary comments/recommendations followed by more minor and detailed comments. I expect the authors can readily address these comments and that, after revision, this will be an interesting and valuable contribution for readership of SEISMICA.

Main comments

1. Additional illustration of the Vp model is needed to better support the discussion of results in section 4 pertaining to upper plate structure. I provide details in comments below but my recommendation is that the authors add a new figure(s) showing depth slices through the 3D volume at upper plate levels to better illustrate the high Vp regions interpreted as Siletz and the dike zone, and the low Vp regions associated with the Alvin Canyon fault and the Newport Basin. The locations of the EW and NS profiles in Fig. 5 and 6 should be indicated on the depth slices (also Fig 7b and Supplement Fig 1) perhaps with ticks at the map edges.

We added a new figure (Figure 5) showing four horizontal slices sampling the upper 0-16 km. The locations of the EW and NS profiles are indicated on the horizontal slices and on the velocity slice above the Moho.

2. Discussion of prior studies and how the new study adds to and compares with prior findings needs to be improved. For example, how does the offshore extent of a high Vp body interpreted as Siletz and inferred dip of the western Siletz boundary compare with prior interpretations? How about onshore structure of Siletz and comparison with prior studies re inferences on Siletz thickness and geometry (e.g. Trehu/Gerdom studies; Egbert et al EM study). How does the upper plate dike location compare with Trehu 2023 study? How do the new findings compare with the CASIE21 findings regarding the Alvin Canyon fault from Carbotte et al. (2024)? See detailed comments below.

We added a map (Supplementary Figure S1) comparing the outline of Siletzia from Watt & Brothers (2021) compared with the thickness of material with velocities greater than 5.5 km/s above the inferred top of crust. The region with 3 km thick section with $V_p > 5.5$ km/s above the inferred top of crust most closely resembles the SES from aeromagnetic data. A description comparing them has been added to section 4.1.1 Accreted Terranes. The high velocity dike in our model closely matches that seen by Trehu et al. (2023) and is discussed in section 4.1.2. Dike. The low velocities associated with the Alvin Canyon Fault are discussed in section 4.1.3 and the change in Moho depth on either side of the ACF is discussed in 4.2 as well as how this compares with results from Carbotte et al. (2024).

3. Section 4.4 Further discussion of model resolution is needed as well as limitations regarding seamount-related Vp anomalies at the top of the plate. First, the model wavespeeds are overall excessively fast at oceanic crust levels, with mantle rock type Vp (~8km/s) modelled in the oceanic crust in places. From a quick visual comparison, the oceanic plate wavespeeds appear much faster than obtained in the earlier Gerdorf et al (2000) study which was based on a subset of the same data used here, with the Gerdorf wavespeeds more plausible.

We reran our inversion with a starting model produced using the same method as Ashraf et al. (2023) with some additional smoothing to reduce sharp velocity gradients at the top of the crust and Moho. This results in more reasonable velocities compared to our early inversions using a Moho from Ashraf et al. (2026) and a 2.5D velocity model created from the Gerdorf et al. (2000) velocity profile.

Regarding the interpretation of high Vp anomalies at the top of the lower plate as seamounts: Vp values of these anomalies are very fast (~7 km/s) for the top-of-crust levels and the vertical dimensions are implausibly large for seamounts. The height of the interpreted seamounts of ~4 km (Table S2) far exceed that of well-resolved seamounts on the incoming Juan de Fuca plate which are ~1 km high (both in unsedimented regions and sediment buried near the deformation front – see Lee et al., 2025). Estimated widths are, conversely, too small relative to typical seamounts. The prominent Axial seamount is only ~1.2 km high and ~30 km wide. Heights of subducting seamount inferred from the CASIE MCS data are much closer to the range of typical Juan de Fuca plate seamounts. Also, criteria for interpreting some high Vp anomalies but not others needs clarification (ie other local fast Vp anomalies are present in the Vp image in Fig 7 and S1 that are not interpreted as seamounts). The hypothesis driven resolution tests presented in Section 4.4 indicate that the inferred seamount Vp anomalies are likely under recovered in their model with the implication that anomalies may be even larger. Would the experimental configuration be able to recover more plausible size seamounts of 1 km in height?

Discussion of these limitations is needed and additional resolution tests would be very useful to include. We reran our hypothesis driven resolution tests with a seamount height 1 km beginning 6 km above the inverted Moho and results show that we are still able to resolve features of this size.

Below we also detail how we added a description of our criteria for identifying seamount anomalies. We added the following text to the clarify why we interpret some regions of fast Vp as seamounts: *“Many anomalies appear within 1 km above the inferred top of the crust. In this study, we discuss only those located in well-resolved parts of our model and exclude anomalies where ray coverage is poor and the lateral extent or shape of the anomaly cannot be resolved. We focus on high-Vp anomalies situated seaward of the Siletz terrane and ignore the similar high velocity anomalies beneath Siletzia except where independent evidence justifies that interpretation, as with anomalies M2 and G2. This limitation is important because the Siletz terrane generates high velocities that can smear downward into the plate interface, creating artificial high-Vp features.”*

1. In the discussion and conclusions an underlying assumption is that the top crust corresponds to the megathrust/plate boundary fault. However, there is compelling evidence that the two surfaces are not coincident in parts of the author’s study region. Earlier MCS studies (McKay et al. 1992, 1995; Han et al., 2017) and the CASIE21 study (Carbotte et al., 2024) indicate that south of the Daisy Bank fault, the plate boundary fault under the outer accretionary wedge lies in the sediment section ~1 km above top crust with a step down to top of crust at deeper levels. This distinction needs to be discussed and text modified where the two interfaces are equated.

With the resolution this technique provides we are unable to distinguish between the top of crust and plate boundary and have clarified this in the paper. We added the following to section 4.3: *“Given that seismic tomography lacks the vertical resolution needed to distinguish the up to ~1 km separation*

between the megathrust fault and the top of the subducting crust identified in earlier MCS work (Carbotte et al., 2024; Han et al., 2016), we examine velocity slices relative to our inferred top-of-crust surface, located 6 km above the subducting plate Moho."

2. Overall the manuscript is quite well written, although it would benefit from another edit with an eye to remove redundancy. I have noted a few locations but there are others. The figures need improvement and I have included below a number of suggestions that would significantly improve the presentation.

Detailed comments

Line 50. Include Watt and Brothers (2021) in citations here as this is a primary reference for segmentation patterns linked to forearc structure.

We added the reference to Watt and Brothers (2021).

Line 52/53. Clarify here which segment boundary you are referring to.

We changed this sentence to: "Recently, Trehu et al. (2023) and Carbotte et al. (2024) presented seismic imaging data indicating the presence of structures in the upper and lower plates, as well as deformation of the plate boundary that may contribute to a segment boundary around 44.5°N."

Line 76. Suggested wording change: "Here, the subducting Juan de Fuca plate is ~8Ma old at the onset of subduction".

We made this modification.

Line 84. Additional brief description of the nature of the Franciscan terrane would be helpful to include. This is old pre-Tertiary to Eocene accretionary wedge sediment and oceanic crust, transported north and emplaced next to Siletz.

We added the sentence: "The Franciscan terrane consists of pre-Tertiary to early Eocene rocks derived from an accretionary wedge sediments and oceanic crust, which were later transported north to their current position (Carbotte et al., 2024; McLaughlin et al., 1997)."

Line 116. Reference should be to Fig. 2b.

We changed the reference to Figure 2b.

Line 124. Wording change: " from studies conducted in 2012..."

We made this change.

Line 133. Add references for the Cascadia2021 (Trehu et al field report) and CASIE21 OBS experiments (Canales et al., 2023). This Canales et al 2023 publication is the primary reference for the CASIE21 OBS data but is missing from the reference list. (Canales et al. *Seismological Society of America* 94, no. 4 (2023): 2093-2109.)

We added these references.

Line 151/152 Clarify that the OBS data from these lines were previously analyzed by Horning et al., (2016) for Line 1 and in Canales et al. (2017) for Line 3. These are primary references for the 2012 Ridge-to-Trench OBS data and provide additional details on acquisition that are relevant for any future user that might be interested in further extending your analysis.

We added references to Canales et al. (2017) and Horning et al. (2016).

Line 167-68. Replace Carbotte AGU abstract with Carbotte et al. (2024) which is the primary publication describing the CASIE21 experiment and links to all data. Also suggest wording change "...using the airgun array and hydrophone streamer of the R/V Langseth"

We updated this reference and made the suggesting wording change.

Line 184. Mostly redundant with line 172.

We removed the redundancy in these lines.

Line 257. Clarify how the 5.5 km/s contour is used to define Siletz. No doubt you are not interpreting Siletz as present beneath this contour all the way to deformation front as could be interpreted from the text/fig (Fig. 5).

Reviewer 1 expressed a similar concern below is our response to them:

You are correct that the Siletz terrane does not extend to the deformation front. To address this comment, we added Supplementary Figure S1 showing the thickness of material greater than 5.5 km/s above our inferred top of crust. We added the following text to section 4.1.1: *"The Vp structure of the overriding plate reveals several distinct velocity anomalies. In the eastern part of our model, we identify a high-velocity body with values exceeding 5 km/s (Ashraf et al., 2025). Based on both its location and velocity characteristics, we interpret this feature as the Siletz terrane. Previous work shows that velocities within Siletzia vary spatially (Gerdom et al., 2000), with an average of about 5.5 km/s in south-central Cascadia (Ashraf et al., 2025). In the outer forearc, overlapping velocities make it difficult to distinguish Siletzia from the downgoing plate. To address this, we use the combined pattern of velocity and thickness, together with the structural boundary inferred from aeromagnetic data. Supplementary Figure S1 shows the thickness of material between the 5.5 km/s isovelocity surface and the inferred top of the crust, located 6 km above the final Moho. Regions containing more than 3 km of material with >5.5 km/s above the inferred top of the subducting crust align most closely with the seaward edge of Siletzia mapped by Wells et al. (2014). The imperfect correspondence between this thickness-based boundary and the magnetic boundary suggests lateral variations in terrane thickness. Accordingly, in Figures 6–7, we use the 5.5 km/s contour, restricted to regions where it overlies more than 3 km of material with $V_p \geq 5.5$ km/s, to approximate the limit of the terrane boundary (Watt and Brothers, 2021)."*

Section 4.1.1. The location of Siletz block in the offshore has been previously mapped primarily from magnetic anomalies but also from prior 2D tomography studies, a few industry wells, and the recent Egbert et al. EM study. Your analysis provides new independent constraints and it would be very useful to discuss further how your findings compare with prior interpretations of extent of Siletz. Depth slices through your Vp model within the upper plate to illustrate where a shallow higher Vp body is present and discussion of how it compares to the magnetics shown in Fig 2 would be very useful.

We added a new figure (figure 5) showing depth slices to illustrate variations in seismic velocity in the upper plate including the extent of the Siletz terrane. In the previous comment we address how we compared our Vp model with the boundary shown in Figure 2.

Line 259. Dip in which direction?

We changed this sentence to: *"...south of 44.20°N it shallows and dips westward at a noticeably lower angle"*

Line 259. Suggested wording change to clarify: "...obvious change in Vp structure at the previously interpreted terrane boundary here between Siletz and Franciscan terranes."

We implemented this change.

Section 4.1.2 To better illustrate the location of the interpreted high Vp dike zone, depth slices through the upper plate should be included. The E-W slices of Fig 5 don't cross the dike and the last panel in Figure 6 is the only convincing illustration of this feature presented.

As noted above, we added a new figure (Figure 5) containing depth slices through the upper plate to illustrate the dike and other upper plate anomalies. We also changed the E-W slices displayed in Figure 6 to include a slice through the dike.

Section 4.1.3 The low velocities associated with Alvin Canyon fault and within the Newport basin are difficult to make out on figures referenced here and need better illustration with a depth slice through the 3D volume at shallower upper plate levels. Ideally a series of depth slices to illustrate the various features discussed in Section 4 should be added.

Depth slices are shown in the new figure 5.

Line 283. Add reference to Fig 5 here – EW-profiles show this as well.

We added a reference to this figure (now figure 6) in this sentence.

Line 284. Need to show the location of the interpreted dike to Figure 7a to support this statement. How does the deflection of the plate under this dike zone reported in Trehu et al. (2023) compare with what you find in your current 3D volume?

We added the outline of the interpreted dike to this figure (now Figure 8a). We also modified Supplementary Figure S3 to compare our Moho with other interfaces from this region include the Trehu et al. (2023) Moho and commented on the comparison in section 4.2.

Section 4.3

Line 293. Location of M1 is referred to here but not shown in Fig. 7b and should be added.

We added it to this figure (new Figure 8b).

Line 300. Confusing. Do you mean feature is located at top of subducting crust rather than at plate Moho?

Yes, we changed the wording here to reflect this.

Section 4.4 The height of Vp features interpreted as seamounts of ~ 4 km (Table S2) are implausible as seamounts. These heights far exceed that of well-resolved seamounts on the incoming Juan de Fuca plate (both in unsedimented regions and sediment buried near the deformation front – see Lee et al., 2025). Axial seamount is ~1.2 km high and 30 km wide. Globally, seamounts are overwhelmingly less than 3 km in height. This section needs revision to include discussion of plausible seamount dimensions and limits of the resolution analysis presented (see main comments).

We adjusted both our starting model velocity structure and our inversion parameters and obtained heights of ~2 km which are more consistent with typical seamount heights. Our hypothesis tests show that due to lateral and vertical smearing along ray paths the spatial extent of these features is over estimated and the velocity perturbations are underestimated.

There are additional localized high Vp features shown in Fig 7b/Suppl1. Please add clarification on what criteria was used to identify some local anomalies as possible seamounts and not others?

We added the following text to section 4.3 to clarify the criteria we used to identify anomalies as seamounts: *“To examine the topography on the subducting slab, we looked at slices of the final Vp model at different heights above the Moho interface to identify the topographic relief on the subducting plate. We observe nine circular regions of higher velocity that are labeled S1-S5, G1, G2, M2, and M4 in Figure 8 and Supplementary Figure S4. Given that seismic tomography lacks the vertical resolution needed to distinguish the up to ~ 1 km separation between the megathrust fault and the top of the subducting crust identified in earlier MCS work (Carbotte et al., 2024; Han et al., 2016), we examine velocity slices relative to our inferred top of crust surface, located 6 km above the subducting plate Moho. Many anomalies appear within 1 km above the inferred top of the crust. In this study, we discuss only those located in well-resolved parts of our model and exclude anomalies where ray coverage is poor and the lateral extent or shape of the anomaly cannot be resolved. We focus on high-Vp anomalies situated seaward of the Siletz terrane and ignore the similar high velocity anomalies beneath Siletzia except where independent evidence justifies that interpretation, as with anomalies M2 and G2. This limitation is important because the Siletz terrane generates high velocities that can smear downward into the plate interface, creating artificial high-Vp features. Additionally, we classify small, circular, high-velocity anomalies within roughly 1 km above the crustal top as seamounts when their amplitude and geometry closely match anomalies independently confirmed as subducting seamounts in potential-field data and multichannel seismic (MCS) images.”*

Line 340. Carbotte et al. (2024) isn't an appropriate citation here. This paper doesn't include speculation regarding relationship between the strike-slip faults and landslides.

We removed this part of the sentence and the reference.

Line 346. In addition to the trajectories shown using the DeMets model, trajectories and estimated times determined for Juan de Fuca motion relative to the Oregon block (poles in Wells and McCaffrey studies) would be very useful to include.

We moved our seamount trajectories calculated from the DeMets et al., 2010 plate motion models to the supplement (Supplementary Figure S6) and replaced the figure with plate motions calculated from the vector addition of the DeMets model (JdF relative to stable North America) and the McCaffrey model (Oregon block relative to stable North America).

Section 5.1. Is there any evidence for slow Vp regions in the upper plate aligned with the predicted seamount trajectories? If these features cause significant uplift and damage in the upper plate, regions of slower Vp (due to faulting, fluid flow) might be expected. Again depth slices through the upper plate would be very helpful to show.

We do not observe slower velocities along the predicted seamount trajectories. It is possible that the damage zone produced by these features does not have a large enough velocity difference to observe using this technique or slow velocities are obscured by smearing of the high velocities of the seamount as shown in the hypothesis tests.

Section 5.2 The hypothesis that seamount interaction with Siletz could be the primary cause of the seismicity found in this region is well described and the author's findings add further support for this interpretation. However, an alternate interpretation proposed in Carbotte et al. (2024) is that the seismicity is related to complex tectonics at the intersection of the Alvin Canyon fault with an ~ E-W shelf structure. A brief description/citation to this alternate hypothesis would be appropriate.

We changed this section to present the Carbotte et al., 2024 hypothesis first. Here is the new passage:
“Cascadia lacks the frequent microseismicity observed at other subduction zones; however, the central Oregon margin hosts two prominent clusters of small- to moderate-sized earthquakes. The southern cluster is located at the intersection of three features in our model: the ACF, a subducting seamount (M2), and the seaward edge of a mafic feeder dike embedded within the Siletz terrane. Carbotte et al. (2024) attributed the observed seismicity to the complex tectonic interactions at the intersection of the ACF and an east-west trending shelf structure.”

Section 5.3 Line 413-419. Carbotte et al (2024) should be referenced in this section for the hypothesis that the Alvin Canyon fault region is a megathrust segment boundary and how your study complements and adds to the findings of the earlier study should be discussed. The CASIE21 MCS study indicates the Alvin Canyon fault system is a margin crossing zone of both locally rough top of crust and plate interface topography that also coincides with a regional-scale change in plate geometry. We propose this is a likely rupture segment boundary based on spatial correlations with margin segmentation indicators. Your findings highlight the likely presence of a series of seamounts in the region (consistent with and in addition to those in the CASIE21 study) that contribute to the locally rough top of crust in this region, you add constraints on Moho structure that are consistent with offset of the crust across the AC fault, and very interestingly, find that the fault zone is associated with slower Vp anomalies. These observations can be better highlighted in context of the earlier study.

We modified the text throughout Section 5.3 to attribute this hypothesis to Carbotte et al. (2024) and more clearly explain what this study adds: *“Carbotte et al. (2024) identify the ACF system as a region of locally rough top of crust and a rough plate interface that crosses the margin. Based on the spatial correlation with margin segmentation indicators, they propose this is a possible segment boundary. Consistent with this interpretation, our Vp model shows that the ACF cuts through at least the upper portion of the subducting crust and extends into the accretionary wedge, where it likely inhibits the formation of large, coherent asperities. Our results suggest that, in addition to the ACF and the seamounts imaged by Carbotte. et al. (2024), several additional seamounts are likely present in this region, further enhancing the roughness of the subducting plate and reinforcing the interpretation that this region may act as a persistent segmentation boundary.”*

Section 5.3

Clarification is needed in this section (and elsewhere) that plate boundary fault and top crust are not coincident throughout this region (see main comments above) and what you can resolve regarding these two surfaces should be discussed.

Due to the resolution of this method we cannot distinguish between these surfaces in our model. We have added text to clarify that by adding 6 km to our inverted Moho we are trying to approximate the top of the crust which does not always coincide with the plate boundary fault. In section 5.3, we added: *“Changes in slab geometry and topography on top of the subducting crust can contribute to a rough subduction interface. This roughness can directly shape megathrust geometry where the two surfaces coincide or produce more subtle changes to the fault interface when the megathrust lies above the top of the crust.”*

Section 5.3.2

Line 430-430. Please clarify re “Siletz terrane dips more steeply”? The Vp model shows a more steeply dipping west edge of Siletz in the north. Is this what is meant?

We changed this sentence to: *“The change in dip angle of the seaward edge of Siletzia could change how fluid builds up along the plate interface.”*

Line 435. Suggested wording change: “from drainage along the Alvin canyon fault.”

We implemented this change.

440-441. The region of lower slip deficit rate in the various plate locking models is much wider than the Alvin Canyon fault region.

We modified this sentence to say “A lower slip deficit rate is observed throughout this region (Schmalzle et al., 2014; Lindsey et al., 2021), which may suggest that this patch of rough crust from the Alvin Canyon Fault and seamounts is decreasing the coupling on the plate interface and promoting interseismic creep..”

Line 450. Delete “and topography of the megathrust.” (See comments above re megathrust residing above top crust).

We removed this from the list.

Line 453, 463 add “**megathrust** segment boundary”

We made this change to lines 453 and 463.

Line 489. Add Canales et al (2023).

We added this reference to the data and code availability section.

Figures

Caption for Figures. 1, 2, 9. Best way to reference your topography data is “topography from the Global Multi-Resolution Topography Synthesis (Ryan et al., 2009).

We added this language and reference to the figure captions.

Figure 1. Edge of Siletz is very hard to distinguish on map - suggest color change.

We made the Siletz terrane boundary thicker to improve the visibility.

Figure 2. Add the interpreted edge of Siletz terrane shown in panel a to d. This will help support later discussion of identification of Siletz from your Vp model relative to magnetic data.

We added the Siletz terrane boundary to every panel of Figure 2.

Caption. Suggested wording change line 4.: “.. location of named **shelf** banks”

We made this change to the Figure 2 caption.

Figure 3. Symbol size is very small and some of the colors very close in tone to topography. The land stations are especially hard to make out

We increased the size of the seismometer symbols and included a black outline around each to make them stand out against the topography color palette.

Figure 4. Can the display of the record sections be improved? Very hard to see any wiggles even zoomed in.

Figure 4 is intentionally displayed as a black-and-white shaded plot rather than as individual seismic wiggle traces. This representation emphasizes trace-to-trace coherence, which was critical for identifying and picking the arrivals used in our analysis.

Figure 6. Add 5.5 km/s contour like in Fig 5 and indicate which of these slices is interpreted to be sampling the Siletz terrane (-124.24, -124.5).

We added the 5.5 km/s contour to this figure (now figure 7) to remain consistent with the east-west slices and labels indicating the Siletz terrane.

Figure 7. Add location of the interpreted dike to Figure 7 to better support the discussion of changes in Moho depth around the dike. For panel 7b- I suggest you substitute Supplement Fig1 (and add seamount labels) which uses a better color bar for illustrating the topography near top of subducting plate discussed in section 4.3. You can move current Fig 7b into supplement.

We added the interpreted dike to this figure (now 8a) and swapped the color palettes on Figure 8b and Supplementary figure S4. Additionally, we added a third panel showing the velocity perturbations from the starting model to highlight the high velocities above our inferred top of crust.

Figure 8 and S3. Use a different color for the top crust and Moho ; the white lines shown are invisible on panel a and hard to make out on panel b. For FigS3 label which seamount anomalies are being modelled here.

We implemented these changes to improve the display of the hypothesis-based resolution tests.

Figure 9 Caption. Give reference for plate motion model used for seamount trajectories. Suggest you also show trajectories calculated using JdF-Oregon block motion from Wells and McCaffrey studies.

We changed Figure 9 to show motion of the Juan de Fuca plate relative to the Oregon block (described above) and modified the figure caption.

Figure S2. I couldn't find this figure referenced in the text. It is useful and should be discussed in section 4.1.3.

We added a reference to Figure S2 in the Low Velocity Zones section.

Figure S4. Could perhaps consolidate with revised Figure S1 (former 7b)?

We consolidated these figures into a single Figure S1 (now S4).

Figure S5. It's difficult to distinguish the thick grey line region in panels C and D. Suggest use a grey transparent filled polygon overlay instead.

We changed this figure to mask regions of our differenced Moho where we lack PmP ray coverage.

Recommendation: Revisions Required