Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-33-RC1, 2019

Solid Earth
Discussions
Open Access

Interactive comment on "Crustal-scale depth imaging via joint FWI of OBS data and PSDM of MCS data: a case study from the eastern Nankai Trough" *by* Andrzej Górszczyk et al.

Andrew Calvert (Referee)

acalvert@sfu.ca

Received and published: 22 March 2019

This excellent paper presents a fascinating case history of the use of wide-angle velocities derived by full waveform inversion (FWI) of a densely sampled 2-D ocean bottom seismometer survey in prestack depth migration of a coincident 2-D reflection survey. The comparison of the results of different approaches to estimating the velocity model is particularly valuable, and the paper is a very good demonstration of the potential of FWI methodology in both imaging of the crust and the complex imbrication found in an accretionary wedge. The paper warrants publication with only minor revisions, most of which are related to English language, attached in an edited manuscript, and I list my

Printer-friendly version

Discussion paper

main comments below.

It would be helpful to comment on which velocity models are in the “migrated” an “unmigrated” domains; for example, when lateral heterogeneity is present, velocities derived by standard stacking velocity analysis are not associated with the surface locations suitable for depth migration. Was this problem addressed when the stereotomography (ST) was applied? In contrast, the interval velocity model from FWI is in the depth domain suitable for migration.

Some discussion on the accuracy of the velocity model is also warranted. With ray-based tomography it is common practice to evaluate spatial resolution using checkerboard tests, or something equivalent, and this method can also be used with wide-angle FWI, though this might prove more challenging when stereo-tomography is included. The FWI+ST model has velocities of 8000 m/s, i.e. mantle, 1-2 km below the top of the oceanic crust, which is unrealistic. Given the reduced constraint at depth documented in Fig. 7c, I doubt the accuracy of the velocities, and their variation, within the igneous oceanic crust. Could this be due to fitting out-of-plane arrivals? These velocity anomalies are less pronounced in the FWI model (Fig. 8c versus 8d). Note that the purple color in Fig. 11 a does not appear on the colorbar. So is the colour scaling in Fig. 11 correct? Can you mask out the unconstrained parts of the velocity models, e.g. the region of zero ray coverage in Fig. 3a.

It is impressive that the velocity gradient increases in the igneous oceanic crust can be extracted from the velocity model. The increases at the top of the oceanic crust and the Moho seem reasonable. Is the thickness of oceanic crust implied here consistent with the known thickness of the incoming plate in this area? It is suggested that the stepping within the Layer 2 gradient zone might be due to thrust faulting, but are these offsets more consistent with normal faulting with blocks dropped to the west; perhaps faulting created as the plate bends into the subduction zone?

Page 12, line 6: I doubt that this velocity variation within the igneous crust is real. Even if it were I doubt that it could be simply attributed to volcanic ridges on the oceanic crust. Fracturing of the oceanic crust can reduced velocities where the incoming plate bends, but would likely be a more systematic, long-wavelength anomaly than shown here.

Pager 13, line 7: It is probable that the igneous oceanic crust would have some deep water, hemi-pelagic sediment cover before it receives any sedimentary input from the land.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-33/se-2019-33-RC1-supplement.pdf

---

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-33, 2019.