Solid Earth Discuss., 7, C1019–C1022, 2015
www.solid-earth-discuss.net/7/C1019/2015/

Solid Earth
Discussions
Open Access

Interactive comment on "Density structure and geometry of the Costa Rican subduction zone from 3-D gravity modeling and local earthquake data" *by* O. H. Lücke and I. G. Arroyo

O. H. Lücke and I. G. Arroyo

oscar.luckecastro@ucr.ac.cr

Received and published: 27 August 2015

We appreciate your comments on the content and structure of our manuscript. We agree that the discussion on serpentinization could be strengthened. Regarding the slab geometry from Arroyo's work, her tomography was used as input for the model so the geometry of the top 60 km of the plate interface on the density model is consistent with that from the tomography.

On the buoyancy of the Cocos plate, the gravity response of a Cocos Ridge crust with lower densities in comparison to the surrounding crust is not consistent with the measured gravity. Any buoyancy would be a consequence of the depressed Moho,

which replaces dense mantle material with crustal material. Once the ridge's crust enters the subduction system, it could behave similarly to the rest of the crust and increase its density due to changes in temperature and pressure. The uplift of the Osa peninsula and the compression along the Fila Costeña may be a consequence of the positive bathymetry colliding with the upper plate.

Wide angle seismic data would definitely contribute to resolve the geometry and could resolve vertical changes in density, however, there is no available data for the area where the Cocos Ridge subducts. The available wide angle seismic data has been incorporated into the model in two ways. First, interfaces such as the Moho and top of the slab from wide angle seismic data were incorporated as constraints for the geometry. Please refer to the attached figure where a 2D seismic cross-section from Sallarès et al. (2001) is projected on to the cross-section of the density model shown in figure 4a of the manuscript . Second, the seismic velocities from Vp were used to constrain the density of the modeled bodies via empirical formulas which are used to obtain density from Vp. The results were considered as a start model from which the densities were modified to achieve best fit with the measured gravity. Since the bodies (or polygons) resolved by the seismic data do not coincide exactly which those of the density model, ranges of Vp were considered and not discrete values. The obtained densities are well inside those ranges shown by the Vp constraints. A summary of the densities constrained by Vp has been published previously by Lücke (2014) and is not explicitly included in the current manuscript. Since it was deemed redundant, we chose to refer the reader to Lücke (2014) for details on seismic constraints.

Regarding normal faulting on the outer rise of the Cocos Ridge, we acknowledge the presence of faulting but consider that the faulting is not as intense as it is for the NW segments and we agree that the thickened crust may impede intrusion of water. Thus, a lower degree of mantle serpentinization is assumed for the Cocos Ridge.

We agree that the slab detachment explanation poses inconsistencies concerning the timing and evolution of the subduction system influenced by the arrival of the ridge.

The alternative model is proposed in order to accommodate a theory by other authors in which a subducted slab is present to a certain depth (as shown by the earthquake hypocenters presented in the manuscript) and then the mantle from the downgoing plate is in contact with the mantle of the overriding plate. As stated, this is not the preferred model.

We look forward to further contributions during the review process and will consider the points risen on the discussion phase in order to improve the manuscript.

Interactive comment on Solid Earth Discuss., 7, 1941, 2015.

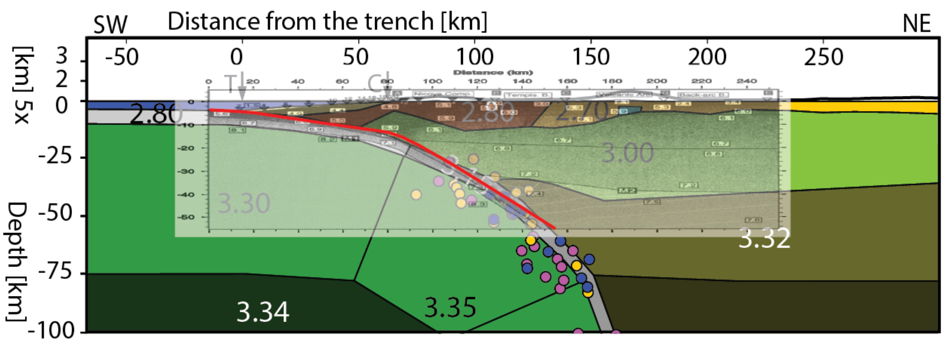

Fig. 1.