Comments on 'Seismic imaging in the eastern Scandinavian Caledonides: siting the 2.5 km deep COSC-2 borehole, central Sweden', by Juhlin, et al.

This paper presents an excellent example of what we all should do to study continental collision and orogenic evolution. It is well written, easy to read and very interesting to follow. The models it proposes are excellent to open a discussion and key for the goal of the project: choosing the location of a 2.5 km depth borehole.

The focus of this work is a ca 55 km long, high resolution vertical incidence seismic profile acquired in Sweden as part of the COSC project, in an area that now represents the middle crust of the Caledonides. It samples part of what is called the Middle Allochtonous and the Lower Allochtonous. It is a complex area with outcropping Proterozoic and Paleozoic rocks affected by folding and thrusting. The basement has been probably affected by different deformation episodes, including Caledonian deformation. The authors present two alternative models to interpret their excellent composite seismic profile (CSP) in order to choose a location to carry out a 2.5 deep drill hole. These models are supported by geological, magnetic and magnetotelluric data in different degrees and both are coherent. Accordingly, it is very difficult to establish one of them as preferred model since both have strong supporting evidences.

General comments

To me, there are two key questions that could help to clarify the interpretations and that, either are not properly discussed in the text or I have missed the point. These two questions could help to discern the origin of the so called (and well deserved) enigmatic reflectivity and to decide which one of the two models is more viable.

1. Is the Jämtland detachment affected by the deformation/reflectivity observed underneath? This point deserves a bit more of discussion. If it is affected, then the reflectivity observed underneath has a high chance to the respond to a duplex/thrusts and this deformation is probably Caledonian, with a sole thrust running much deeper than the Jämtlandian detachment (model 9a). If it is not, then reflectivity (deformation) is previous and hasn't had reactivation during the Caledonian Orogeny. If it is slightly affected, the deformation might be previous to the Caledonian Orogeny but might have been slightly reactivated. At the sight of the profiles, the third case looks more likely and would support model 9b.
2. Is the Olden–Ovilksfjällen (O-O) antiform thrusted above the Jämtland detachment or it is underneath it. I find confusing evidences to discern this question in the map and the text. On the one hand, Figure 3 shows a cross-section where further to the SE, Neoproterozoic sedimentary formations seem to have been previously thrusted and the later development of the Jämtland detachment (JD) has carried them further east in a piggy-back style. If this also applies to the O-O antiform, it would be above the JD and would not need to be related with the reflectivity observed underneath it since it was probably folded before it was thrusted. In this case, model 9b would be more viable. It is true, however, that the reflectivity observed underneath the JD shows

some evidences of a basement high coinciding with the O-O antiform, but this deep reflectivity does not show any evidence of the Offerdel Synform suggesting that deformation above and below the JD might not be simultaneous and have no relation at all. In this case, morel 9b would be also more viable. On the other hand, the text seems to suggest that the O-O antiform is a basement culmination in which case, the JD is above it and should outcrop somewhere near this antiform. However, I don't see any evidences of that in the map. In this case, the 'enigmatic reflectivity' could of course be represented by model 9a and correspond to Caledonide basement imbrications. The sole thrust would run deeper than the JD and more coherence between deep reflections and surface features should be expected. Do the lithologies and the contacts (thrusts) observed in the O-O antiform support such a high reflectivity like the one observed underneath the JD?

Another question that could be explained in more detail is related to the high reflectivity observed in the Are synform and the Seve Nappe. Is this reflectivity similar to the one observed in CSP below the JD? When you say that prominent reflective units that do not outcrop in the eastern limb of the Are synform are expected at depth, do you mean in the middle allochthon or below? One possibility is that the 'enigmatic reflectivity' could be representing the extended outer margin of Baltica developed during the opening of the Iapetus(?). The reflectors could respond to normal faults, intruded by dykes and then slightly reactivated in the Caledonian orogeny. I guess this interpretation would also require estimations of shortening in the Seve Nappe and the imbricated Neoproterozoic outcrops. In any case, the pattern of the reflectivity is tectonic, i.e. that of a duplex (extensional and/or compressional). But the continuity of reflections suggests that lithology is also involved. In my opinion, faults are very heterogeneous and very seldom give such a continuous and well defined reflectivity unless they follow high impedance lithological boundaries. In this case, the magnetic highs could be related to these dykes. In fact, they appear more or less where these reflectors reach shallower levels (CDP's 2500, 3400, 4100 and even in 4800-5400, where even though the basement is supposed to be high, the magnetic field decreases but if has relative highs related to reflectors?).

As very minor comments:

Page 17: Line 11: …some OF which…?

Page 21: Line 26:…is present in A klippen?

Fig 7: Total magnetic field 'anomaly'? With values of 50000nT I think is not an anomaly but the total magnetic field. Also, is this data reduced to the pole?

In summary, I think this is a great paper that could be accepted as it is, although I would appreciate some more clarification/details regarding the comments posted above.