

**Comments on Seismic imaging across fault systems in the Abitibi greenstone belt –
An analysis of pre- and post-stack migration approaches in the Chibougamau area,
Quebec, Canada, by Saeid Cheraghi et al**

This paper discusses the processing strategy to apply to vertical incidence seismic reflection data in order to get best subsurface image along crooked-line acquisitions. In that regard, I think the paper is excellent. The analysis it makes of the importance of CDP bin centers in relation to CDPs location and maximum offset, together with the need of undertaking cross-dip move out tests is crucial to get the best resolved image. However, I'm a bit disappointed about the interpretation of the data. I don't know if the goal of this paper is to present also a geological model of the area, as they don't really do it. At this point, I don't see a clear relationship between the faults and the reflectivity. As an example, the Doda fault does not seem to have a seismic response in the southern profile. The width of the reflectivity associated to the Guercheville and Barlow faults is much higher than the trace of the faults themselves. So what is the reflectivity responding to? Deformation or lithological contrast? Is the later related to Au mineralization or not? In relation to this, the map in figure 1 lacks information about dips and a cross-section where we can have an idea of the structure. Finally, to round up the conclusions, both profiles should be plotted overlapping the entire seismic profile, presenting the overall structure of the area. As it is now, the paper is a good technical work with limitations regarding the interpretation. Finally, even though there are native English speaking researches among the authors, I find the text awkward sometimes. Conclusions read like a telegram, and some parts of the text do not flow properly. So a revision of the grammar and style would be convenient (from my point of view).

Ahead I give more details about the points made above. I also add some other minor comments

Line 16-17: Would help to know what type of faults are them. Strike slip, normal or reverse? As there is not a proper stratigraphic column in the legend, the kinematics of the faults is difficult to infer

Line 23: In the northern?

Line 24: structures or the key geological structure....

Line 83: Fig. 1 does not show ...the NE portion of the Abitibi super-province. A regional scale map (at least as the inset in figure 1) where this province appeared will be much better.

Line 84: Same applies for the ages of rocks. Include them in the legend of Figure 1 and not only in the text so we can have a quick idea of the structure. Right now we don't know which ones are older or younger.

Line 252: ...various constant velocities between 5000-6500 m/s, with a step range.....?

Line 258. Here you start presenting results but the whole thing is quite messy. A new paragraph (add inter-paragraph space as you do in other places, e.g., between lines 295 and 296) should start in line 258 and another one in line 264 (The design of the north....)

Line 268:Labelled in Fig. 5, chn1.....

Line 271. Those reflections project to the surface off the CDP line, so rephrase. Is not that they show no correlation with the surface geology. We don't see it. And the map you provide in Fig 1 lacks detail, but some could be related with the Burlow pluton southern boundary?

Line 282: I don't see chs5 and6 as subhorizontal. If something, chs5 has a hyperbolic geometry with high opposite dip to ch6 in its deeper part

Line 272:.....one kilometer...you are using km and numbers so it should be 1 km.

Line 276: New paragraph again (interparagraph space)

Line 284: I'd like that title to be more specific.

Line 289: Change to.....When out-of-place CMP's scattered/reflected seismic waves from steep structures off the CDP line (cross-dip direction) exist, cross-dip analysis addresses.....??As it is now, the phrase does not read well. I think you make an excessive use of semi-colon when you could replace it by commas or new paragraphs.

Line 311: Remove...Table 3 shows.....segment. It is already mentioned in the previous paragraph

Line 312: Remove...Table 3 shows.....segment. It is already mentioned in the previous paragraph.

Line312: Remove.... The DMO-CDMO stacked sections are essential for the diffraction imaging. This is not the place for that assessment.

Line 314:.....depths lesser than.....

Line 322: ...40° to the south and features lesser continuity (Fig. 9c). You should also take into account the continuity of the reflection

Line 356: High resolution seismic profiles....

Lines 435: Unconformities are identified in vertical incidence data when the reflections they truncate are visible???. In my opinion it is more likely that chn1 responds to lithological variations inside the Opemisca Group.

Lines 436: This interpretation of chn2 is incomplete. What is the structure of the Opemisca Group there? Why doesn't it respond to another change in lithology?

Line 443 and fw: Rewrite, as there are articles missing. For instance:

The CDMO analysis around reflections chn3 (Fig. 8) would suggest a 0°-10° strike towards the east (Fig. 8c and 8d, Table 3). **Furthermore**, these reflections became weakly imaged assuming **a** CDMO toward **the** west (Fig. 8a 445 and 8b) or toward the east at dips greater than 10° (Fig. 8e and 8f). **Finally**, the CDMO analysis **also** indicates an eastward apparent dip for other upper crustal reflection packages of the north profile (chn1 and chn2, Table 3).

Line 456:.....provided insights....

Line 457:.....they are potentially relevant....

Line 456-480: You need to rewrite that part as you merely do a description, but not a discussion. So discuss, e.g., why CDMO should help in imaging diffractions given the geometry of the waves in the latter. Also, you can discuss what you think they represent. As it is now, there is no discussion in there.

Line 524-525: This is a really interesting problem. But there should be ways to address it. The south profile is oblique to the fault at the cross-point so in Figure 9c you are imaging an apparent dip. But apart from knowing the angle between the profile and the fault at that point, you also know that real dips are higher than apparent dips. So probably the best image of the fault is that where its reflection looks shorter and steeper. This should help you to provide the real geometry associated to that feature. Moreover, addressing your preferred image of the fault in figure 9 is part of what a discussion should be, instead of just saying that the fault has a complex geometry (something that is not clear from the map, as it looks subvertical and simple).

Lines 531: What is the dip of rocks at the surface??? This implies again the need of a geological map with layer dips and a cross-section.

Line 536: If interpreted as a fault, reflection chs4 most likely correlates to the Doda fault?. But Doda fault projects at CDP 100 and these reflections project outside the profile! Even if dip changes and the fault becomes subvertical, you are imaging things at 2 km in the migrated section and nothing at the surface where the Doda Fault projects. It seems unlikely that chs4 represents that fault. Finally, at the cross-point with the Doda Fault, the profile is oblique, so you are seeing apparent dips. Does Figure 9 provide better insights about this fault? This should be better discussed.

Line 541: Those reflections are not subhorizontal. They have opposite dips and suggest a syncline structure.

Lines 557-558:.... joint complex structure of the Guercheville fault **as well as** the Doda fault **in the south** are **all** imaged within the greenstone belt rocks of the upper....

Line 559:....deep reflections: chn5 and chn6.....Do not mix reflectors and reflections.

Conclusions: I don't see the Doda Fault anywhere in the seismic section. It projects around CDP 100 in the seismic profile and there, the strongest reflectivity is at 2-3 km. You need to discuss that in the discussion part, but it is not a clear conclusion with the present discussion.

Table 2: Is it necessary to be that specific in step 6? Is not enough to say V^2t ?

Does the time to depth conversion use velocities higher than migration velocities? Explain or change

Figure 1: Geological map should have dips. Furthermore, a cross section along the profile should be presented. I'm sure there are has been plenty of structural geologists working on that.

Figure 4: Caption-.....shot and CDP locations **are** also.....

Figure 5, 6 etc: Add N and S in the edges of the profile. Although the reader can figure out the dip of reflections, it is faster to indicate the orientation in the profile itself.