Sparse 3D reflection seismic survey for deep-targeting iron-oxide deposits and their host rocks, Ludvika Mines-Sweden

by Alireza Malehmir et alii

This paper is reporting the results of a new (non-conventional) 3D seismic data acquisition, performed for mining exploration in Sweden. The authors well show how the combination of a careful and customized survey planning and optimized processing allow to achieve better results in comparison to a standard 2D survey, with reasonable costs.
The manuscript represents a good contribute for the scientific progress in mining exploration, currently a very "hot" topic, presenting this case history as a reference example for extending this approach to other cases.
This paper fits the scope of SE. It is complete, well-structured and well written, even if I've found a bit difficult to follow the interpretation details on the figures. Therefore, some updates on the figures are required. This manuscript can be accepted for publication after a minor revision.

General comments:

Please find here below some suggestions for possible improvements:

1) shorten the abstract
2) integrate the geology chapter adding at least a few of information and references (if available) about the known formations and geological (regional) evolution of the study area. More important, the structural information require integration on the light of the final interpretation proposed by authors. Please add at least few sentences and references on the actual stress regime and therefore describe which type of regional (master faults) are mapped in the study area (the main lineaments can be added in Fig.1a as well). These info are important to aid readers not expert on the study region and guide them to the final interpretation.
3) the interpretation should be improved, particularly when introducing the figures 10 to 14 which should be mentioned sequentially in the text.
4) Figs. 12-13-14 can be reduced to three instead of four, and increased in size. Please consider using this scheme: a) only short labels (M1, F1 etc..) b) interpretation labels (such as "Mineralization" etc..) c) only the interpreted model without seismic data

Specific comments:

line 11: add "of physical properties"
line 30: rephrase
lines 37-38: rephrase
line 238: which software was used for the processing?
line 245: add a citation for GRM method
line 258: the filter in table 2 is reported as 20−30−150−160 Hz. And detail which type of BP filter was used
line 260: in table 2 authors report 20−40−130−150 Hz. Please double check and add filter type
line 266: unclear, please explain better and rewrite
line 283: is this result visible in any figures or supplementary material?
line 295: briefly add few details in the text about deconv step mentioned in the figure caption
line 311: "estimated bedrock…" please better clarify in which way
line 316: so, is it a normal fault? W-dipping? Please clarify
line 321: in which way the bedrock depth of Fig. 9d has been obtained? literature, boreholes or seismic data analysis? Again, please clarify the procedure.
lines 333-334: please check comments of figure 10
lines 353-354: unclear. Are the diffractions in the intersection point? Clarify
line 363: add label F1 in 12a
line 364: I would remove the actual 12b
line 370: will be (c) if authors will remove (b)
line 373: this explain the low angle for a normal structure? Clarify
line 373: meaning a normal fault or normal dip-slip kinematic?

lines 374-375: I suggest to introduce such info about geologic and structural background also in the geology chapter
lines 378-379: please consider move this sentence after "history" at line 375
line 382: add F3 label in fig.12a
line 386: why excluding F1 to be the master fault and the F3 a younger one with higher angle? Its strike direction is basically similar. Please justify better your interpretation on the light of the available literature.
line 389: add F2 label in Fig.12a. All the features displayed would benefit in visibility increasing the size of the figure (3 images instead of 4, as already suggested above)
line 394: there is a continuous “ping-pong” between the figures mentioned in the text. The text should be reorganized so that the figures can be called out sequentially.
line 496: “in Sweden” only? the paper has a potential broader interest, not only in Sweden.

Technical corrections:

lines 21-22: …where the use… was relevant.
line 39: Vanadium
line 41: change with “. In fact, because”
line 42: change with “whilst”
line 73: “ , but ”
line 133: , thus
line 307: add P4 and P5 labels in fig.9a
line 389: change Fig.12 with Fig.12a
line 391: change with “… feature. However, if…”
line 473: change with “tailings and bedrock”
line 473: change with “...lineaments. These information were...”

Figures:

Figure 1:
- the lines in (a) paths are poorly visible, a more transparent base map may help.
- some labels have a too small font, please fix.
- old profiles along P1 are not visible? Did they have the same length and position? can be reported on this map? If not add in the caption “not shown in this map”.
- figure (a) would benefit of a more detailed insert, or zoom in the lines to better display all the information described.
- BB14004 should be highlighted better, the white arrow is not well visible (consider a different colour or symbol).

Figure 2:
- colours are different from fig. 1A, I guess due to the scale-bar. However, define better yellow and black colours in a legend or within the caption.

Figure 10:
- I suggest to change the figure orientation to horizontal.
- add a colour-bar with amplitudes.
- please add NE-SW labels on the crossline and NW-SE labels on the inline to aid the readers.
- the black arrow on the left side is again F1 (?) if yes add the label.
- add F1 label in the time-slice.
- the position of labels D1 and D2 generates confusion. Please use circles for example to better highlight them and/or please move labels close to the diffractions.
- M3 is reported in the migrated version in fig.11. Can be labelled also here in the unmigrated line?

Figure 11:
- I suggest to change the figure orientation to horizontal.
- add a colour-bar with amplitudes.
- please add NE-SW labels on the crossline and NW-SE labels on the inline to aid the readers.
- can be M3 added also in the unmigrated line of fig.10?

Figure 12:
- please consider to add in (a) only the labels of previous figures (f1, f2, M etc..) without the interpretation ("long" labels in b – ex c).
- remove fig. 12b, it doesn't extra information in comparison to c.
- then in figure c (- ex d) leave only the interpreted model without seismic data.
- faults symbols in fig.12d are thrusts, not normal faults.

Figure 13:
- again, I suggest to remove one figure, in this case the 13d.
- the refined deposits layer is already well visible in (c), so the label can be moved there.
- I suggest the use of only three (vertical) figures with increased size for better display.

Figure 14:
- I suggest to remove fig.14b.
- again, consider to use:

    a) only labels M1, M2, F1 etc..
    b) in 14b (ex -14c) the interpretation with all "long" text labels.
    c) 3D model + 2D data (?).

- increase the size of all the three figs 14abc.

Tables:

Table 2: double check filter parameters within the text and add deconv parameters.
Table 3: detail on the first raw the fault type (normal ?).