

Review of:

**Vectors to ore in replacive VMS deposits of the northern Iberian Pyrite Belt: mineral zoning, whole rock geochemistry, and use of portable XRF**

By:

Guillem Gisbert, Fernando Tornos, Emma Losantos, Juan Manuel Pons, Juan Carlos Videira

The submitted manuscript presents a study aimed at identifying geochemical indicators of VMS deposits, applying geochemical and petrographical data to the Aguas Teñidas deposit of the Iberian Pyrite Belt as a case study. The authors discuss in considerable detail the implications of their data for economic exploration in similar settings worldwide. Additionally, the latter portion of the study focusses on a rigorous test of the applicability of handheld XRF to identify the described geochemical trends, comparing directly data derived in the field and data derived from conventional laboratory analysis (WD-XRF/ICP-OES/ICP-MS).

The manuscript is well written, the background material is, to the best of my knowledge, adequately cited and provides sufficient context, the figures are clear and well-designed, and the supplementary information provides a wealth of information which is highly relevant to the results of the study. I congratulate the authors on a well presented, detailed, and thorough manuscript which I enjoyed reading.

I believe that the results of the study are highly relevant and entirely worthy of publication. However, my only major concern lies in the overall clarity of the manuscript. The manuscript is approximately 16,000 words in length, and some of the main points that the authors wish to disseminate are a little lost in the structure of the paper, which can at times be quite confusing, particularly when considering both the volume and the diversity of the presented data. Sometimes it is hard to tell where the literature data stop and the new data presented in this study begins. I think the structure could be revised to compensate for this without necessitating the removal of material. For example, I would suggest that the section currently entitled "4. Results and discussion" should be divided to ensure that the results of the study are presented in a strictly non-interpreted manner, followed by a discussion that refers back to the previously presented data. The new discussion section, now unburdened from the voluminous description of the data, could then be more thematic in its approach, discussing key topics and referring back to the results. This decoupling of the interpretive and non-interpretive aspects of the study would, I believe, make it significantly more impactful and less confusing for the reader.

Finally, I think the pXRF component of the manuscript is a little understated, and appears as something of an 'add-on' at the end of the manuscript. This is a bit of a shame, as I feel this component of the study is extremely valuable. To some extent, this might be the result of having confined so much of the pXRF details to the supplementary information, although I appreciate there may be manuscript length constraints, which I leave to the discretion of the editor. Nevertheless, I think there is still some scope to tie this component of the study in a little more than it is currently. I think this is one of the best aspects of the paper and a valuable contribution to ongoing studies surrounding hand held XRF.

Below, I provide some more specific comments on the text:

Line 3: Worth spelling XRF out in full in the title?

Line 14: This sentence is quite long and hard to follow

Line 17: VMS districts where? Worldwide?

Line 17-21: Worth numbering each clause for clarity I think.

Line 21: First instance of XRF – could be defined here.

Line 22: hydrothermal alteration *zone*?

Line 25: Indices or indexes? Perhaps both are valid.

Line 26-27: The first clause is more of a statement of quantity (enrichment), second clause is a process (leaching). This reads a little strangely to me, but it might just be me.

Line 40: Change 'and an inevitable' to 'as well as an inevitable'?

Line 43: the mineral systems of this study?

Line 60: This figure is extremely helpful. If anything, I would make it larger. Also, the term CCPI is not defined in the caption.

Line: 92: Change 'ambient rocks' to 'local lithologies'?

Line 97: 'de centre' should presumably be 'the centre'?

Line 102: geochemical zoning patterns?

Line 108: You can probably delete 'related to' in both instances

Line 119: I would give the ages here for context

Line 135: Could clarify here, are these silicic sediments presumably?

Line 137: The end of this paragraph could be numbered to enhance clarity

Line 143: Change 'Subsequent to deposition' to 'Following deposition'

Line 148: Greenschist should be one word

Line 151: This paragraph is quite disjointed and hard to read.

Line 156: As a native English speaker, I instinctively want to change this to 'The Aguas Teñidas deposit', both here and at various points throughout the text. However, I defer entirely to the authors knowledge on the correct usage of the name.

Line 175: This figure could use some more information. Is the orientation given on the upper image the same for both? Is the vertical scale the same as the horizontal scale? The numbered black lines are boreholes, but this is more apparent coming back to the image than when first seeing it.

Line 183: Change 'At a large, deposit, scale' to 'At deposit scale'?

Line 205: MATSA is given in the caption but not defined.

Line 220: No need to abbreviate Unit I think. Also, the first lithology in the table should contain fewer felsics dykes rather than less.

Line 227: Greenschist facies was mentioned earlier. Was that not the IPB?

Line: 238: You could give more info on the other techniques used. E.g. SEM and petrographic microscope? Also, I would give more specific info on the sample prep and the techniques used for the

geochemistry. I think this is critical for the comparison between conventional lab and hand held XRF. What sort of precision and accuracy were obtained from the conventional techniques? How does this compare?

Line 245: I think the classification of cores and being proximal or distal could be made much more apparent. It is a little hard to work out which cores are which at the moment. Even a very small table to refer to would be useful.

Line 257: This supplementary info is quite important, and could probably be more included in the main body of the manuscript than it is currently. Even some of the key figures could be helpful to make the points.

Line 266: This extra sentence doesn't need to be on its own.

Line 273: Change 'allows extending them' to 'allows their extension'

Line 275: Given the range of alteration events that the IPB has undergone, I think a brief summary table/figure would be justified, so that the reader can immediately establish which parts of the deposits were subjected to which sorts of alteration and when.

Line 278: Change 'materials' to 'lithologies'?

Line 283: Change 'crystals' to 'phases' and give examples? Olivine and pyroxene presumably.

Line 288: Change 'with alteration degree' to 'with the degree of alteration'. Also, the following sentence is a little unclear. I think it might make sense if you just removed the 's' from 'phenocrysts', depending on what you are saying is a pseudomorph of what.

Line 294: Change 'presenting' to 'containing'

Line 299: Hydrothermal alteration *zone*?

Line 311: These are presumably sample numbers as well as depths? Worth adding the units for clarity?

Line 347: Should this be 'interface'?

Line 348: Could change 'disseminations' to 'disseminated bodies'?

Line 356: Clarify where Bathhurst Mining camp is.

Line 358: Change 'halos' to 'haloes'

Line 371: 'and 3) the trace...'

Line 380: The two plots should be labelled as A and B

Line 385: Change 'recognizing' to 'the recognition of'

Line 423: Remove intruded. Intrusive lavas could cause some confusion.

Line 425: Change 'drillings' to 'drill cores'?

Line 450: Change 'similarly' to 'similar'

Line: 483: Change 'from crustal origin' to 'of crustal origin'

Line 490: I would probably add a key to each of the figures. There is enough space I think, and it makes life a lot easier for the reader.

Line 508-512: A valuable point, well made.

Line 526: This is the first occurrence of this delta value. I appreciate it is defined afterwards, but it should ideally be defined at first occurrence to avoid confusion.

Line 540: These are excellent summary plots, I feel that a few more of these would be both beneficial and entirely justified.

Line 557: These depletions could be quantified for context.

Line 568: Change 'to chlorite-rich' to 'with chlorite-rich'

Line 574: This sentence could be integrated with the paragraph below.

Line 577: Two occurrences of 'broad'

Line 580: Here and elsewhere, these appears to be inconsistent use of elements reported as either the oxide of the element. Is this for a reason? If not, it should be consistently applied.

Line 633: Change 'Consistently to' to 'In agreement with'

Line 650ish: This where I feel another summary figure which highlights some of the geochemical trends described in the text would be useful. I'm not sure what is possible, but perhaps something that puts these trends into perspective in the context of the deposit would be useful.

Line 662: Change 'Differently from' to 'In contrast to'

Line 707: Wirth adding a reference or two for this statement on percolation.

Line 733: ',we searched *for* geochemically'?

Line 765: Spell out mercury at beginning of the sentence

Line 768: Worth clarifying where the Rosebery deposit it?

Line 815: This key could be a little more clear. I found it hard to establish what was what in the plot.

Line 819: Is this still talking about pressed pellets? If so, why is homogeneity a problem?

Line 839: Change 'variations within the mantle.....' to 'between mantle...'

Line 840: Change 'or' to 'and'

Line 850: Change 'on its own' to 'on their own'

Line 853: At this point, a significant portion of the major element section is spend discussing trace elements.

Line 869: This is a very valuable figure. This sort of comparison would be worth adding to, if you have more data.

Line 882: Change 'too high' to 'unacceptably high'

Line 901: 'Discrimination' diagrams

Line 902: change 'elaborated' to 'presented'

Line 912: Change 'alkalis' to 'alkali'

Line 913: Correct tense? Was released?

Line 947: 'In addition, *the presented* data...'