

## **A solar optical hyperspectral library of rare earth-bearing minerals, rare earth oxides, copper-bearing minerals and Apliki mine surface samples.**

Koerting, Koellner, Kuras, Boesche, Rogass, Mielke, Elger and Altenberger

Earth System Science Data-Copernicus

### **General Comments**

This paper provides an overview of several spectral libraries developed on REE-bearing oxides and minerals as well as copper-bearing minerals and rock and soil samples. The use of these VNIR spectra in remote sensing is valuable for the exploration industry, and can be applied in environmental type studies. In addition, the authors have indicated they provided geochemical validation of the samples by various means. The paper is succinctly written and is supported by a supplement as well as several datasets.

There is room for improvement in all the documents. Access to the Potsdam University datasets was not easy, and without a password for logging in as “anonymous” I did not obtain access to the geochemical data for review (except in one case). However, I was able to access the text files of the spectral data, and was able to re-plot them. I have no issues at all with the spectral data. One set was not plotted in the datasheets (REO powders) and this should be added, similar to the REE-bearing minerals. The authors should also explain exactly what they mean by geochemical validation-to show the composition of the samples, or to show a relationship between composition and absorption minima?

Suggest authors to visit [doi.org/10.4095/315690](https://doi.org/10.4095/315690) for a look at a Spectral Library on REE-, U-, Th- and Nb-bearing minerals by Percival et al., 2019.

### **Specific Comments and Editorial Suggestions**

#### ***Main Text***

##### Abstract

Line 18: Not sure I would call this an “extensive” collection of minerals

Line 23: “openly available” – I could not access the geochem datasets as I had to have an account at Potsdam University or set up an account. I had no desire to do this. These data sets should be available as the spectral library was made available, or somewhere there should be a note as to how to access the files as a guest.

##### Introduction

Line 37-38: Suggest changing this sentence, as the Spectral Library is not based on the geochemical validation-it is the hyperspectral measurements. Suggest: “In this study, the spectra were collected under standardized laboratory or field conditions and include geochemical validation of the sample materials.

Line 39: add a comma after “example”

Line 40: “elemental” from a hyperspectral viewpoint, I would see Fe as the main element observed (i.e., in gossans), as REE-bearing minerals tend to be in trace amounts, very small, hence seeing the NIR signature may be masked by other minerals such as clays or carbonates etc.

Line 40: “artificial surfaces”-what does this mean? Cut or polished surfaces?

Line 41: use “mapping” singular form

Line 46: should references be in chronological order from oldest to youngest?

Line 48: Turner et al 2014a is out of order in the ref list.

Line 49: Delete “also” between the verbs, maybe start sentence with “Also, ....”

Line 50: add “hand” in front of “samples” [hand samples]

Line 51: core-use singular form; delete “melt evolution”. Melt evolution is something you may study in igneous petrology, and would need very detailed mineral chemistry to “visualize”

Line 68: add “in” after “shown”

Line 69: Start a new paragraph here with “we are...”

The information provided in lines 69-80 becomes repeated again below. Try to limit this, especially in such a short paper.

Line 84-88: Delete, as this is repeating what noted earlier. Add the last sentence to the end of the previous paragraph. “The spectral libraries....” after the url address.

### Materials

Line 97: delete “here presented”; use “comprise”

Line 97-98: repeated from the introduction, can probably delete this first sentence and begin with: “The REE sample material includes 16 REO....”

Line 99: change “comprises” to “includes”, delete “used”

Line 100: Were these purchased from Alfa Aesar? If so, then say purchased; if they were “donated” say that, but not “received”.

Line 101-102: “...of the specified REE based on their concentration certificates, which can be found....”  
Line 104: “specimens”; “denotation” is not correct here in this usage-do you mean “notation” or “abbreviation” or identification”?

Line 106: “denotation” same issue-named or noted? Why should the reader consult the data description to validate the name? I could not access the XRF results- I think this should be re-worded.

Line 103: where is the appendix and Tables A2 and A3? Do you mean Supplement and Table S2 and S3?

Line 109: ditto Tables A4-A5

Line 111: “measurement campaign” to collect samples, map, do field work or just measure using the cameras? Can you say “field campaign”?

Line 115: Table A6?; “overview of sample...”

Line 116: Correct all references to appendix if it is the “supplement”

### Sample preparation and spectra collection

Line 122: “depended”

Line 123: “number of pixels”

Line 124: “compiled” rather than “collected”? Add a comma after “Thereby, ...”

Line 125: “spectral homogeneity”

Line 129: comma after “measurements”

Line 132: “pixels”

Line 135: use “example” not “exemplary”; copper-bearing minerals [need hyphen]  
Line 136: Table A5-Table S5 in the supplementary information?  
Line 140: use “example” not “exemplary”; change “non-existent” to “lack of”  
Line 145: Change: “...powdered so that > 85% of the sample was < 75 μm”  
Line 147: “tablet’s metal frame” [need apostrophe]

#### HySpex data recording

Line 156: why is the beginning bolded?  
Line 157: combine sentences by deleting “.the two cameras are”  
Line 162: do you mean “sleigh”? sleight means cunning-check definition.  
Line 164: ditto  
Line 167-169: need a reference added in here  
Line 179: change “exemplary: to “example”

#### Thermo Niton XL3t (XRF)

Line 227: Bring up to the paragraph before; this is a field-portable or hand-held instrument, not “mobile”  
Line 227-233: This is repeated in the data set paper, why include this detail here. If this is the preferred place, then shorten that in the data set paper. Principles of XRF analysis are not really needed, can refer to a paper on this subject.  
Line 233: place praseodymium before neodymium as this is the order in the Periodic Table.  
Line 236: use “made of plastic with a plastic foil...”  
Line 237: “built-in”  
Line 238: “not “used software” but “software used”  
Line 239: Delete “the” in front of “mining and exploration” and delete “mode” [already noted in Line 238]  
Line 240: “identified” do you mean “attributed”?

#### Scanning electron microscope (SEM) and Electron probe microanalyzer (EPMA)

Note that EPMA should be used rather than EMPA, so change terms accordingly in the text and in tables  
Start this section with Lines 259-266: SEM should be described first.  
Line 265: “qualified”-do you mean “quantified”? Change next line to “Based on previous results, divergences of up to 5 wt% can be expected, which for quantitative analysis is considered acceptable”.  
Line 266: Change “of a total to” to “and normalized to 100 wt%” [this is problematic]  
Line 250: change electron microprobe (EPMA) to electron probe microanalyzer (EPMA)  
Line 253: delete “respectively”; List background count times on EPMA, especially for the trace elements.  
Line 254: Measuring F in fluorapatite is problematic using EPMA. At a minimum, the Area-Peak Factors method should be used otherwise result is usually spuriously-high values.  
Line 256: EPMA  
Line 257: Give reference for the data reduction routine used.  
Line 268-274: delete, and any additional information incorporate with the EPMA section.  
Line 271: “Analyses were calibrated using natural....”  
Line 276: “...the full SEM and EPMA data files...”

Line 282: “EPMA”;

Line 284: ditto in Table caption. Whys is Table abbreviated to Tab? Add “column” after “comment”

#### Apliki mine sample analysis at Bureau Veritas Minerals

Do not need name of company in the section subtitle. Rather than the information you have provided, I suggest you write out what the analyses are-and refer to the packages via their website. For example “ geochemical analyses of the Apliki samples were completed by Bureau de Veritas (location) using their standard packages (website). Samples were pulverized and then digested using aqua regia and major, minor and trace elements were determined using ICP-MS” etc.

Line 290: why was one sample analysed using “aquatic” What is so different about it-this is worth explaining. The code info is better placed in the data sheets information.

#### Validation and discussion

Line 306: Delete “This section will discuss the” and start with “Technical....”

Line 307: Add “are given below” after “error”

Line 310-314: Only certificate info provided as validation for the REO powders

For REE minerals, there is no table comparing the results from the XRF vs. EPMA and indicating if the results are actually comparable. For the geochem analyses by BVM there is no information on how good the data is, no comparison of duplicates, no CRM’s, unless this is also held in the University site.

Line 321: use “measurements” twice, maybe state “averaging multiple measurements minimizes variations in the data”?

Line 327: change “bigger” to “larger”

Line 335: Change “denotation” to “species”

Line 336: add commas before and after “for example”; use “degree of weathering” and delete “grade”

Line 337: provide information on how to obtain easy access to this geochemical data.

#### Data availability

Whys is this section bolded?

Line 349: Delete “here presented”

Line 350: change “are presenting” to ”present”

#### Sample availability

Line 357: Table S5? Note that “Table” should be capitalized throughout the paper-inconsistent.

#### Appendices

Line 365: So here are “appendices” but only one Table {do not abbreviate Table}

#### References

Turner et al, 2014a is out of order, Turner 2015 should be first (single author). Leave a space between Tong et al and the turner reference.

## Figures

Fig. 1: This is very good and provides a good image of what your paper is about. Suggest that the spectral pattern for chalcopyrite be a darker colour, cannot see the yellow; also the malachite should be a continuous line like the other three.

## Tables

Table 1 is not really necessary-you can summarize that info in the text.

Suggest combining Tables 2, 3 and 4 into 1 as many parameters are common. So you can have more columns relative to each of the different mineral groups.

Table 5: The header "Concentration level determination" does not relate to what you have placed in the rows. What are they? All you do is re-reference the data sets. Likely this Table is not critical to the paper.

Table 6: What about adding in the probable interferences for analysing the LREE with a hand-held XRF instrument. This provides very little information to the reader.

Table 8 and 9: Is this really important? You have not noted any samples numbers in the text so there is information for the reader in table 8. This should be in an Appendix if deemed critical.

Describe the analyses and how they are done –that is more important.

Table A1: rather than "not commonly" use "less commonly" in caption. "List of less commonly known terms and their abbreviations used throughout the paper."

MS-Excel™ I believe needs to be added

## **Mineral spectra and chemistry of 32-rare-earth minerals and rare-earth oxides including niobium- and tantalum-oxide**

Koerting, Hermann, Boesche, Rogass, Mielke, Koellner and Altenberger

Earth System Science Data-Copernicus

### **General Comments**

See comments for main paper

Authors did not plot the spectra for the REO powders-why?

### **Editorial Suggestions**

#### Citation

References: Koerting et al. 2019, Koerting et al. 2019a, and of course there was a Koerting et al. 2019b in the paper. For the data sheets, maybe use 2019 a and b? Maybe editor can resolve this.

#### Abstract

Line 5-6: "...tantalum-oxides commonly associated with REEs".

Line 6: change "bigger" to "larger"

#### Samples

Line 1: use Table 1 [cap T]

Line 3: Were these REO powders purchased or were they donated? Change "received"

Line 4-6: "...REE and were accompanied by concentration certificates (Table 4). Delete other "delivered together" and "these....description".

Line 8: "...online trader of minerals specimens"; use "notation" rather than "denotation", or "name" or "identification"

Line 9: change "data" to "results"- Why should the reader consult the data description to validate the name?

Line 10: ditto on "denotation"

Line 11: Where is Table A2 and A3-are these S2 and S3? Should be In Supplement rather than Appendix? Last sentence: "All of the samples were analysed as part of the MSc...and PhD...."

Table 1: Gadolinite [missing e]

Remove extra periods

Note; Ideal Formula

#### Hyperspectral measurements

Line 1: Why is the first part bolded?

Line 2: combine this short sentence with previous one (as in the paper) "...two line scanning cameras mounted in parallel"

Line 3: Add "region" after (...2500 nm)"

Line 6: "sleigh"

Line 9: ditto

### Geochemical measurements

Line 1: “corresponding concentration level determination”-what does this mean? Do you mean geochemical method? There is nothing in Table 3 about concentrations.

Use EPMA

Table 4: Curious, how did these two co-authors modify the certificates of purity for the REO powders?

(lines numbered after Table 4)

Line 2: electron probe microanalyser (EPMA)

Line 6: use “hand-held” or “field portable” rather than “mobile”

Line 13: place Pr before Nd [order in P.T.]

Table 6: I believe this is Table 5

(lines numbered after Table 5)

Line 1: change “additionally” to “also”

Line 2: EPMA [I realize on the website it is listed as EMPA-but most now use the term EPMA]

Line 2: comments on probe info-see editorial suggestions for the “paper”

### 8.1 Spectra: ENVI Spectral Library

Relatively easy to see the spectral data and plot each sample out individually. For the REE minerals, can identify them by the numerous deep reflections, especially in the NIR. What is really needed, is to identify which REE corresponds to which reflection-as in Turner’s 2015 thesis (and published papers 2014). This is the test for validation.

Why did you not plot the REO powders in the same format in this section?

### 8.2 Geochemical Analyses

I do not see REO analyses in any table, certainly not in Table 5.

Note Excel™ should probably include the trademark symbol [throughout the paper]

I could not access geochemical data by XRF nor EPMA.

Fig. 3 caption: use “example” rather than “exemplary” [wrong meaning]

Note: sometimes able is not capitalized, sometimes Figure is shortened to Fig. under the figure. Be consistent.

### References

Sometimes the date is at the end, other times after the authors.

## **Mineral spectra and chemistry of 20 copper bearing minerals**

Koellner, Koerting, Horning, Mielke and Altenberger

Earth System Science Data-Copernicus

### **General Comments**

The information provided in this data description is similar to what is provided in the Supplement, especially the fact that both have the Table with photos of the samples. I believe this is the place where that should be held, and maybe the Supplement does not need to be so extensive with images.

For this set of data, I was able to open the EPMA results as well as the SEM images and EDS analyses. I assumed that the EPMA of the 25 analyses match the samples depicted in the SEM file, however that was not the case. It would be very useful in the EPMA files to indicate the sample name using the abbreviations provided (A1, A2, A3, etc.) for cross-reference. Also, as you have several samples of one mineral, averaging their mineral chemistry and calculating an actual mineral formula would be most useful. This can be also calculated for the individual samples.

With respect to the EDS results shown in the pdf. Fil, is there any reason to indicate “H2O missing”? What is more useful is to explain this in the data sheets, and emphasise that EDS analyses are normalized and WDX analyses are not.

### **Editorial Suggestions**

#### Citation

Line 1: Change “bigger” to “larger” [ditto in abstract]

#### Abstract

Line 1: there are 20 samples, but only 7 or 8 different minerals (native copper, azurite, malachite, chalcopryrite, plancheite, brochantite, linarite, and an unknown). Why is the unknown still unknown? Is it possibly a new mineral? Is it crystalline or amorphous? What is the XRD trace of this mineral?

Line 4: For this group of data it was accessible.

#### Samples

Line 3: delete “(EDX)” and “(WDX)” [noted under methods]; in brackets should be “(SEM)” and “EPMA)”

Figure 1 caption: use “example” not “exemplary”; change “non-existent” to “lack of”  
“...example of all sample scans to highlight the lack of sample preparation”

Line 5: Delete “previous” [can use “prior”]

Line 10: change “for” to “of” [area of the geochemical...]



Table 1

What is spicular? [M5 and L1]

Table 2

Add the initials used to indicate mineral name at end of caption.

### Hyperspectral measurements

Line 1: why bolding used?

Line 2: combine sentences [as noted in other review docs]

Line 3: add “region” after wavelength brackets

Line 6 and 9: “sleigh”

### Mineral chemistry

Line 7-8: “qualified”-do you mean “quantified”? Change next line to “Based on previous results, divergences of up to 5 wt% can be expected, which for quantitative analysis is considered acceptable”.

Line 10: EPMA

Line 17: ditto

Line 18: change “validated” to “estimated”.

### 7.1 ENVI Spectral Library

No issues with the spectral data; can open the data files. What validation has been done between the spectral signature of a samples and its geochemistry?

### 7.2 Detailed sample list with measured parameters

Excel™

### 7.3 mineral chemical analyses

You provide an example of the raw data for EPMA analyses. Why not summarize the chemistry in a table and indicate calculated formula for each mineral?

What are the ore minerals?

Q: text file with copper mineral chemistry for 25 samples-this appears top relate to the pictures in the pdf of “copper minerals chemistry”-correct?

What are the 51 copper minerals in the other text file?

Figure 6 caption. Use “example” not “exemplary”

# **Mineral spectra and chemistry of 37 copper-bearing surface samples from Apliki copper-gold-pyrite mine in the Republic of Cyprus**

Korting, Rogass, Koellner, Kuras, Horning and Altenberger

Earth System Science Data-Copernicus

## **General Comments**

The information provided in this data description is similar to what is provided in the main paper and the Supplement, especially the fact that both have the Table with photos of the samples. I believe this is the place where that should be held, and maybe the Supplement does not need to be so extensive with images.

For this set of data, I was not able to open the geochemistry results. I was able to open the spectral files and re-plot the spectra.

## **Editorial Suggestions**

### Citation

Line 1: “larger” rather than “bigger”

### Abstract

Line 3: change “sampled” to “collected” and “of the” to “with the”

Line 8: ditto “bigger”

### Samples

Line 1: use: “The 37 samples were collected” or “Thirty-seven samples were collected...”

Line 2: what is the “measurement campaign”? Was this a hyperspectral measurement field trip?  
delete “Cyprus in front of “geological”

Line 4: “pulverized so that  $\geq 85\%$  of the samples were  $< 75 \mu\text{m}$ ”

### Hyperspectral measurements

Line 4: “the area for the sample’s spectra was...”

Table 2:

See comments for the Supplement documents

What is “soil-ish”?

Some samples are described as “white with pink”-what are these, soils, gravels or rock?

### Geochemical analyses

Line 2-3: Table 3 and Table 4

Table 3 and Table 4 were also in the main paper-they are not really important here; provide a web address. I think a description of the method is more valuable to the reader. Also, need to provide accuracy and precision information, there is no mention of duplicate or CRMs being analysed. Geochem data could not be accessed.

### 81. ENVI spectral library file

No issues with the spectral data; can open the data files. Plotting them in one image makes most very flat. What validation has been done between the spectral signature of a samples and its geochemistry?

### 8.2 Extensive sample list and measured variables

Note Excel™ needs a trademark symbol

Table 6 or 7 not identified

Are these needed? Repetitive from Tables 3 and 4? Why was aquatic method used on one sample?