Reviewer 1:

Comments and Suggestions for Authors

This study established a rapid quantitative identification criterion based on the basic chemical compositions combination rules in the red beds. The manuscript is well written and the topic is interesting and novel. By comparing the chemical composition combinations of 15 kinds of rocks collected from China in this study, it is proven that the quantitative criterion proposed in this study are effective. The work performed in the manuscript is comprehensive and in-depth. However, there are some minor problems that should be addressed before any further publication process.

Response: Thank you very much for your review of this manuscript. The following are the revisions made to the manuscript one by one based on your comments.

Required changes:

Point 1: In fact, the second section on methods is very rich in content. It mentioned previous research on the comparison between red beds and other rocks. But in this chapter, whether this part of the content overlaps with the introduction. Please provide a reasonable explanation. Additionally, as this section is too lengthy, it is recommended to add a suitable flowchart to facilitate better reading for readers. In addition, in section 2.1, the principle and instrument photos of the handheld elemental analyzer appear slightly monotonous. A schematic diagram can be formed by combining its principle and instrument photos.

Response 1: We have revised the last paragraph of **1 Introduction** based on your suggestion and adjusted the content of the paragraph regarding to **2 Methods**. For the convenience of readers to read better, adjust the position of Figure 1 to **2 Methods** according to your suggestions. The schematic diagram of the handheld elemental analyzer has been added (Figure 3).

1. Introduction Lines 67-70

"Therefore, the purpose of this study to develop a quantitative criterion for quickly and accurately identifying the red beds. This study first collected the data about the geomorphic characteristics, mineral content, and chemical composition of red beds and other rocks, then compared these data to obtain the basic characteristics of red beds, and finally summarized and analyzed the red beds identification criterion and verified the reliability of this criterion."

2. Methods Lines 73-77

"Figure 1 shows the methodology used in this study involving the investigation of geomorphic characteristics, mineral compositions, and chemical compositions (the perspective of chemical compositions is the focus of this study). In this study, data on geomorphological features, mineral content and chemical composition of the red beds and other rocks were first collected, then these data were compared to derive the basic characteristics of the red beds, and finally the red bed identification criteria were summarized and analyzed, and the reliability of the criteria was verified."

2.2 Criterion verification Lines 152-156

"The working principle of this instrument is that a miniature X-ray source provides tube voltage and tube current, and the light tube emits continuous X-ray spectral lines. The X-rays irradiated on the sample knock out the inner electrons of the K and L layers of the element atoms, and the holes in the low-energy layer are filled by high-energy outer electrons (N layer). The high-energy electrons emit excess energy as X-ray fluorescence (Kα) with elemental characteristics. Thus, the instrument detects the type and concentration of elements through the emitted spectral lines."

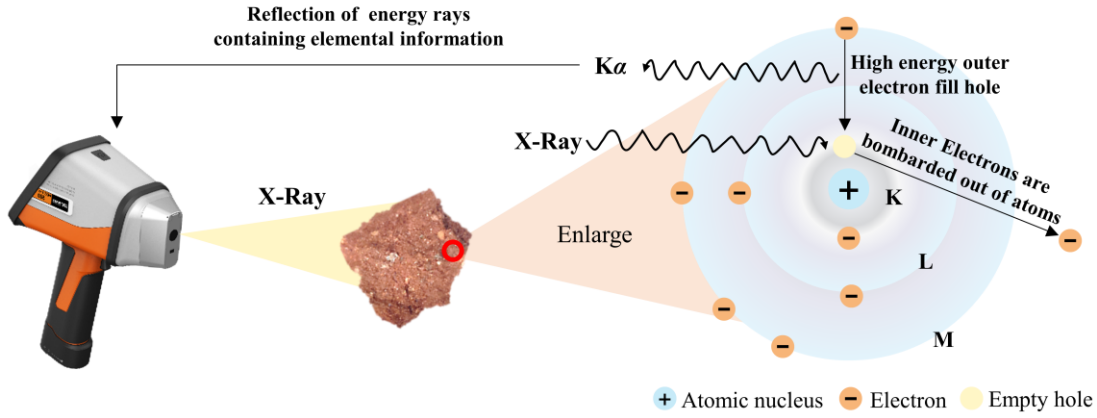

Figure 3: MiX5 Pro handheld X-ray fluorescence element analyzer.

Point 2: In the third section of Results and Discussion, both sections 3.2 and 3.3 describe the results through tables or figures. In section 3.1, it was found that the geomorphic characteristics of the red beds were mainly described through literature review, and the content was not rich enough. Can appropriate figures or table data be added.

Response 2: In Section 3.1, the identification of red beds is qualitatively explained by adding Figure 4 to illustrate the geomorphic characteristics of the red beds.

Red beds Yadan landform　　Red beds Danxia landform

Figure 4: Geomorphic characteristics of the red beds.

Point 3: Some general recommendations regarding the presentation of contents. (1) figure 2. I suggest writing "Location of the study area" and, if possible, add a description of what there is in the photo. For example, can the sample be dispersed by adding a map of China. (2) In the research status of the introduction, it should take a positive attitude towards the previous research results on the whole and deny them praise. It could talk about advantages before disadvantages. (3) Do the colors in the small figures in Figures 4 and 5 represent the same type of rock? Please make a note or add a picture frame in the image. (4) Can Table 3 also be presented in the form of an interval graph, and then 15 types of rocks can be scattered in this interval for intuitive judgment and verification.

Response 3: (1) Sample locations have been added to Figure 2 and labeled on the map of China. (2) The Introduction provides a positive evaluation of previous achievements and points out the research that still needs to be carried out in this manuscript. (3) The same legend in Figures 4 and 5 represents the same type of rock, as explained in the figure title. (4) Table 3 has been modified to indicate the differences between these rocks and the red layer through orange shading.

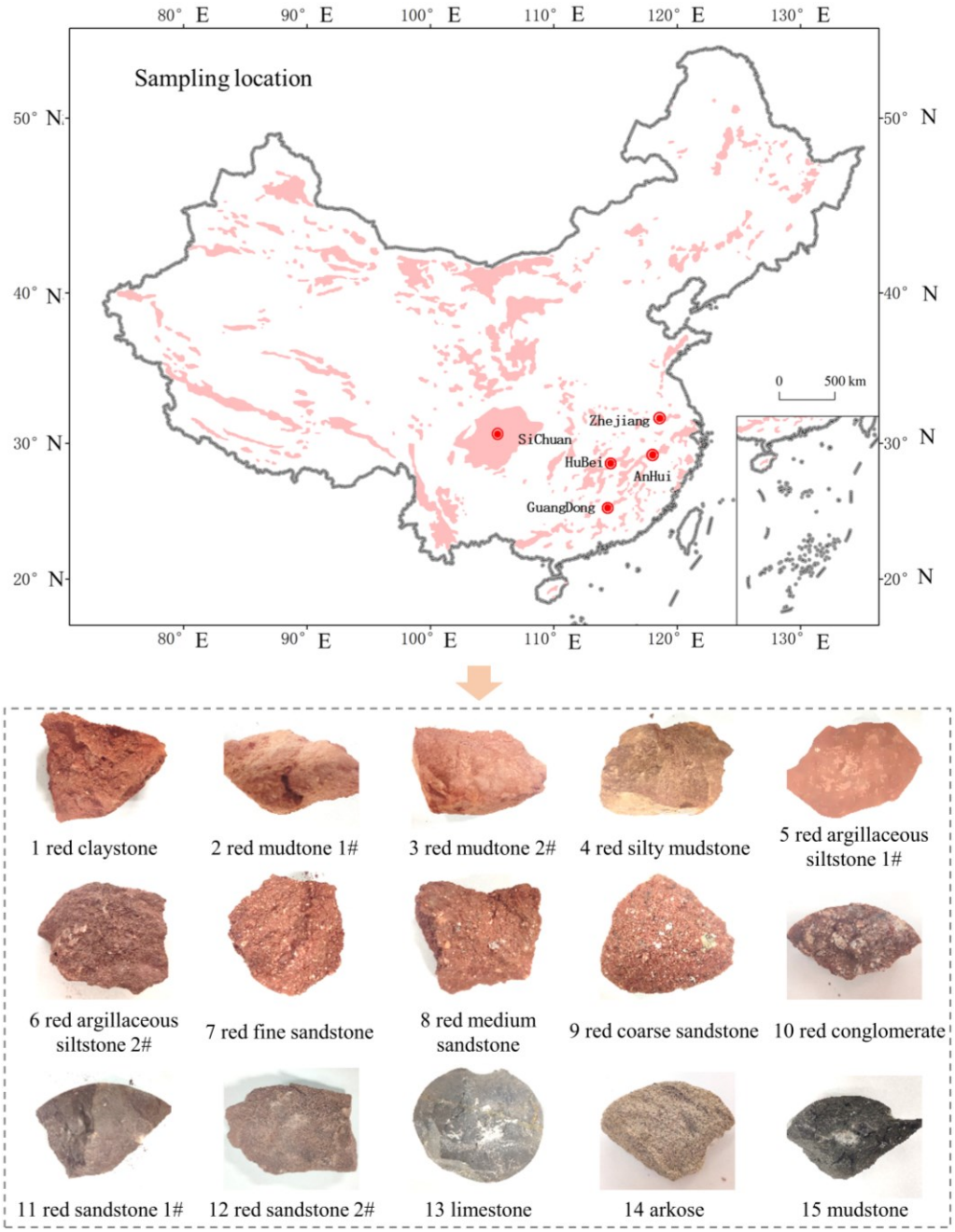

Figure 2: Distribution areas of red beds in China and sampling locations for 15 types of rocks.

1 Introduction Lines 55-56

"At this stage, the research on the geomorphology, mineral color and clay content of the red beds lays the foundation for the identification of the red beds, but this identification is still vague and needs to be further quantified."

Figure 6: Comparison of (a) SiO_2 and Al_2O_3, (b) FeO and Fe_2O_3, (c) K_2O and Na_2O, (d) CaO and MgO contents in red beds, igneous rock, and metamorphic rocks, respectively (Note: Icons of the same color in the figure have the same meanings).

Table 3: Chemical composition combinations of 15 kinds of rocks.

No.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	FeO (%)	Na_2O (%)	K_2O (%)	MgO (%)	CaO (%)	SiO_2+ Al_2O_3 (%)	Al_2O_3/ SiO_2	FeO+ Fe_2O_3 (%)	Fe_2O_3/ FeO	K_2O+ Na_2O (%)	Na_2O/ K_2O	CaO+ MgO (%)
1	43.3	15.0	2.9	0.7	0.2	1.9	3.3	1.1	58.3	0.35	3.6	4.12	2.1	0.10	4.4
2	45.8	18.3	4.1	1.0	0.3	2.6	2.3	0.0	64.1	0.40	5.1	4.12	2.9	0.10	2.3
3	40.1	15.5	3.7	0.9	0.2	2.1	3.6	0.0	55.6	0.39	4.6	4.12	2.3	0.10	3.6
4	48.8	14.3	3.1	0.7	0.3	2.9	2.9	6.1	63.1	0.29	3.8	4.12	3.2	0.10	9.0
5	62.0	15.8	2.7	0.6	0.3	3.2	3.1	0.0	77.8	0.26	3.3	4.12	3.5	0.10	3.1
6	42.8	9.4	1.6	0.4	0.2	1.5	0.4	4.1	52.2	0.22	2.0	4.12	1.7	0.10	4.5
7	52.2	17.1	1.5	0.4	0.2	2.3	2.5	0.0	69.3	0.33	1.9	4.12	2.5	0.10	2.5
8	58.3	18.6	1.6	0.4	0.2	1.9	4.0	0.8	76.9	0.32	2.0	4.12	2.1	0.10	4.8
9	39.9	11.2	1.3	0.3	0.2	1.5	3.9	0.0	51.1	0.28	1.4	4.12	1.7	0.10	3.9
10	48.2	9.6	1.0	0.2	0.2	2.4	3.5	1.9	57.8	0.20	1.2	4.12	2.6	0.10	5.4
11	50.5	14.2	2.1	0.5	0.2	2.3	0.8	5.1	64.7	0.28	2.6	4.12	2.5	0.10	5.9
12	45.1	8.4	3.5	0.8	0.2	2.0	2.3	1.6	53.5	0.19	4.3	4.12	2.2	0.10	3.9
13	13.6	2.3	0.1	0.1	0.2	0.5	3.2	39.6	15.9	0.17	0.2	1.23	0.7	0.33	42.8
14	56.9	14.9	0.3	2.3	0.2	1.3	3.3	1.1	71.8	0.26	2.6	0.11	1.5	0.18	4.4
15	69.7	21.2	0.6	0.7	0.3	0.5	0.9	0.0	90.9	0.30	1.3	0.87	0.8	0.61	0.9

Point 4: Problems in the tables and figures in the manuscript. Please carefully check the accuracy of the units and formats of all tables and figures. Such as, the format of each tables and figures needs to be consistent before and after.

Response 4: We have standardized the format of all figures and tables in the manuscript based on your suggestions.

Point 5: Some general recommendations regarding the contents of the paper. I found that the authors do not use the unified and correct significant figures and decimals in the whole paper (e.g., 43.5 and 0.40 in the Table 3; 2.0% and 30% in the Figure 6). It is necessary to correct the whole paper for accuracy and precision. And item 1 in conclusion is too general and appears to be not connected well to the presented results. Has the current problem been resolved, please either remove or be more specific. Minor grammatical problems in the full text need to be corrected.

Response 5: (1) We have reviewed and revised all the figures and tables in the manuscript. The component content and its sum in Table 3 are expressed to one decimal place, while the component content ratio is expressed to two decimal places; The sum of component content in Figure 6 is expressed as a percentage, while the ratio of component content is expressed as a numerical value. (2) The first conclusion item in the manuscript has been supplemented. (3) The grammar of the manuscript has been

checked and revised.

4. Conclusions Line 325

“(1)…… It solves the current problem of fuzzy identification of the red beds.”

Reviewer 1:

Cui et al.'s research aimed to address the issues of slow recognition speed and inaccurate recognition results of red beds. Based on the correlation between red beds geomorphic characteristics, mineral compositions, and chemical compositions, a rapid quantitative identification standard was established based on the basic chemical composition combination law of red beds. The research content of this manuscript is very interesting, the research methods are reasonable, and the research results are very valuable. However, there are still some minor issues with the manuscript. The following modifications are suggested for the manuscript to be published in this journal:

Response: Thank you very much for the reviewer's review. We have made revisions to the following issues item by item based on the feedback provided.

-Lines 28-30: After verifying the quantification criterion for red beds recognition, it is necessary to further explain the application scope or prospects of this criterion.

Response 1: The application scope and prospects of the quantification criterion for red beds recognition have been added in the last sentence of the abstract.

Abstract

"The study results can be used for rapid identification of red beds, achieving risk assessment and rapid response of geological disasters such as landslides."

-Lines 76-77: The results of Moonjun et al. cited should be placed in Lines 51-52 to illustrate the relationship between geomorphic characteristics, mineral compositions, and chemical compositions.

Response 2: This sentence has been revised and placed in the second paragraph of the Introduction.

1. Introduction

"And, there is a close relationship between these perspectives (Moonjun et al., 2017; Bankole et al., 2016; Perri et al., 2013)."

-Lines 88-90: The description of this sentence is not accurate. The data of red beds and other rocks not only comes from previous studies, but also from some database. It is recommended to modify or delete it.

Response 3: This sentence has been deleted from the manuscript.

-Lines 100-101: This statement regarding the relationship between geomorphic characteristics and mineral compositions should be explained before Lines 51-52.

Response 4: This sentence has been revised and placed in the second paragraph of the Introduction.

1. Introduction

"At present, the studies on red beds identification are mostly carried out from the perspectives of geomorphic characteristics, mineral compositions, and chemical compositions (Cui et al., 2022; Zhou et al., 2021). And, there is a close relationship between these perspectives (Moonjun et al., 2017; Bankole et al., 2016; Perri et al., 2013)."

-Lines 111-112: This statement regarding the relationship between chemical compositions and mineral compositions should be explained before Lines 51-52.

Response 5: This sentence has been revised and placed in the second paragraph of the Introduction.

1. Introduction

"At present, the studies on red beds identification are mostly carried out from the perspectives of geomorphic characteristics, mineral compositions, and chemical compositions (Cui et al., 2022; Zhou et al., 2021). And, there is a close relationship between these perspectives (Moonjun et al., 2017; Bankole et al., 2016; Perri et al., 2013). For example, the content of Fe_2O_3 or hematite in the red beds is higher than that in the grey beds (Hu et al., 2006)."

-Line 122: The "." in parentheses should be deleted, please check the entire text.

Response 6: All the "." in this paragraph have been removed.

-Lines 164-168: After sampling, please explain the processing flow of the sample before conducting the test.

Response 7: The process of conducting on-site testing on samples after sampling has been explained in the manuscript.

2.2 Criterion verification

"After on-site sampling, use a hammer to smash the rock block out of the fresh surface. Then, the fresh surface was analyzed using the MiX5 Pro handheld X-ray fluorescence element analyzer (Figure 3) from

Sun Yat-sen University to check whether these elements conform to the basic chemical compositions combination rules of red beds proposed by this study."

-Lines 201-202: It is necessary to clarify the specific meaning of "geomorphic characteristics" here.

Response 8: The specific meaning of "geometric characteristics" has been explained in detail in the manuscript.

3.1 Geomorphic characteristics of red beds

"Compared with the obvious layering and red appearance characteristics of red beds, igneous rocks and metamorphic rocks do not show the two characteristics of red appearance and bedding at the same time."

-Lines 331-332: Here, it is necessary to provide a detailed explanation of what rocks "non red beds sedimentary rocks" refer to.

Response 9: The specific types of "non red beds sedimentary rocks" have been explained in detail in the manuscript.

3.4 Red beds identification quantization criterion verification

"There are some chemical composition combinations of the 3 non-red beds sedimentary rocks (limestone, arkose, and mudstone) that are outside the scope of the red beds quantitative criterion (the numbers in bold and underlined in the table)."

-Line 376: "by" should be changed to "in", please check the grammar of the entire text.

Response 10: The grammar of the manuscript has been checked and revised.