Global Journal of
Archaeology & Anthropology
ISSN: 2575-8608

Juniper PUBLISHERS
key to the Researchers

Short Communication
Volume 13 Issue 5 - June 2023
DOI: 10.19080/GJAA.2023.13.555858

Glob J Arch & Anthropol

Characterization of Color and Composition in Chert for Grouping and Comparison

María de Uribe-Zorita[1], Pedro Álvarez-Lloret[1], Silvia Bottura[2] and Celia Marcos[1]*

[1]*Department of Geology, University of Oviedo, Oviedo, Spain*

[2]*HERCULES Laboratory, Évora, Portugal*

Submission: June 23, 2023**; Published:** July 05, 2023

***Corresponding author:** Celia Marcos, Department of Geology, University of Oviedo, C/ Jesús Arias de Velasco s/n 33005, Oviedo, Asturias, Spain

Abstract

Color is one of the most commonly used characteristics in archaeological studies to differentiate and describe chert. In this study color parameters of a collection of cherts from different outcrops have been quantified using reflectance's measured in the range of 300-800 nm with a spectrophotometer; in addition, the color cluster analysis and the correlation between color and chemical composition were analyzed with SPSS program.

Keywords: Chert; Color; Reflectances; CIELab; SPSS

Introduction

Chert is a rock of siliceous composition whose major phase is micro to cryptocrystalline silica in addition to other phases present (micas, carbonates, iron oxides, etc.) as well as organic matter that gives flints dark tones [1]. Chert is one of the most important materials used as a resource by Stone Age humans, and color is one of the most used characteristics in archaeological studies to differentiate and describe chert. Chert shows a great variability of color and texture along the same geological formation, as pointed out by Frederick Ringstaff [2]. This property is difficult to determine, as it depends on many factors, as the perception of the person observing it, the external light source providing the illumination, the composition, structure and texture of the chert. The objective of this study was to quantify color parameters and to analyze the correlation of color with chemical composition. The final purpose is to have color references of chert from different geographic and geological origins for use in archaeological tool characterization studies.

Methodology

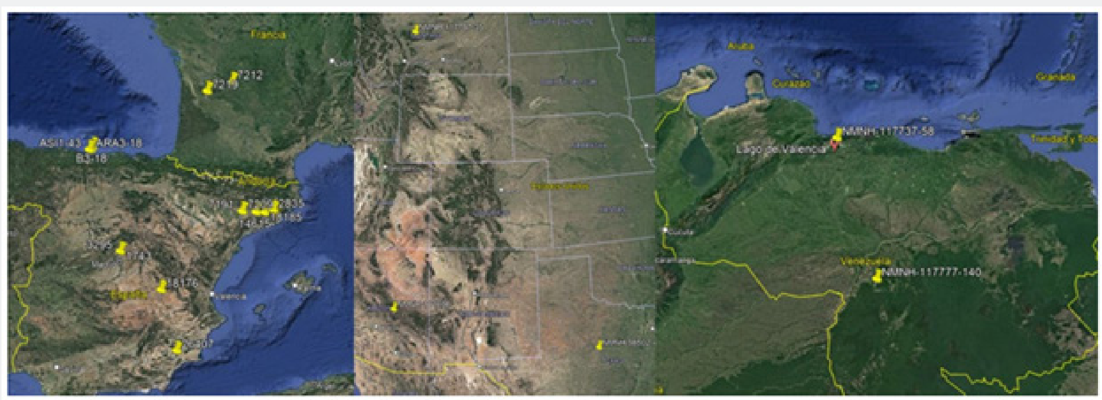

Figure 1: Geographical location of the analyzed cherts outcrops.

The analyzed cherts belong to outcrops from different geographical locations, mainly European (Spain and France) and American (USA and Venezuela) (Figure 1). The composition of the elements expressed in oxides (%) has been obtained by X-ray fluorescence with a Shimadzu EDX-720 equipment. The chromatic coordinates were obtained from the chert reflectances measured with an Edinburgh Instrument FS5 spectrophotometer in the range of 300- 800 nm, at 5 nm intervals. The CIE 1931 diagram [3] was used to represent the chromatic coordinates. RGB code and CCT (K) color temperature were obtained using the NIX converter [4]. The color cluster analysis and the correlation between color and composition were calculated with the SPSS statistical program (IBM SPSS Version 24).

Results

The results obtained from the quantification of the color parameters and the oxide composition of the flint samples are presented in Table 1. The Pearson correlation between the CCT(K) and the oxide composition of the studied cherts (Table 2) is, in general, very low, except for Fe_2O_3 (-0.8), TiO_2 (-0.6) and SiO_2 (0.7). In the CCT (K) dendrogram (Figure 2) 3 groups have been established, concordant with the groups established in the CIE 1931 chart (Figure 3a) and Figure 3b. Black flint samples have not been considered because they are outside the CIE chart.

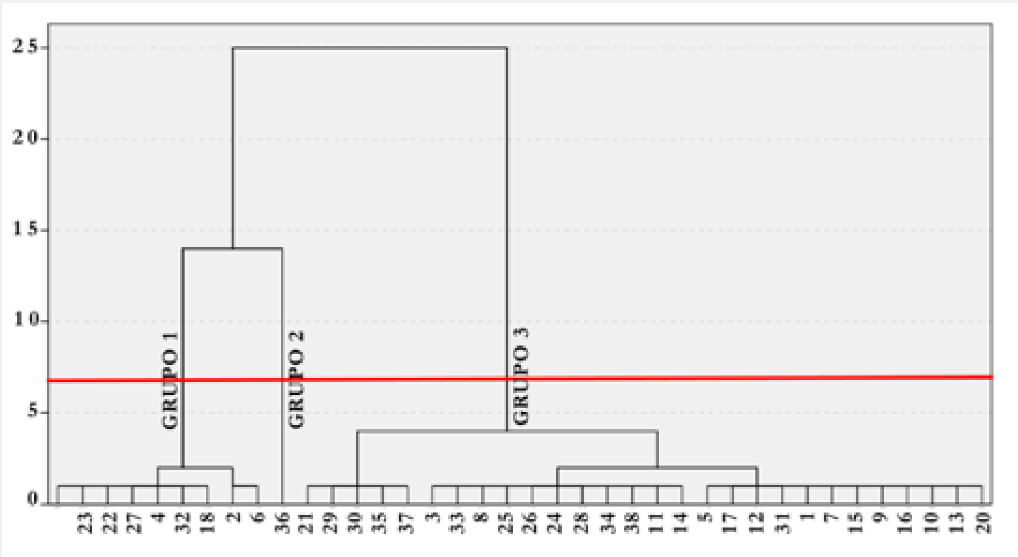

Figure 2: Dendrogram of CCT(K) obtained with the method of linkage within groups and Euclidean distance squared.

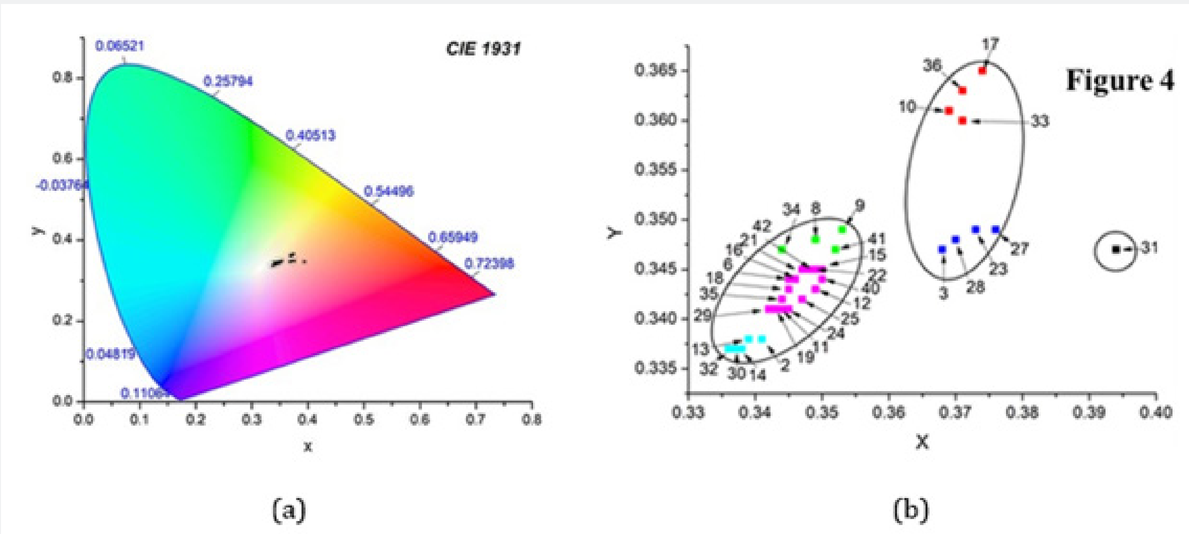

Figure 3: Graphical representation of the chromatic coordinates of the cherts studied in the CIE 1931 system (a) and x-y coordinates.

How to cite this article: María de U-Z, Pedro Á-L, Silvia B, Celia M.Characterization of Color and Composition in Chert for Grouping and Comparison. Glob J Arch & Anthropol. 2023; 13(2): 555858. DOI:10.19080/GJAA.2023.13.555858

Table 1: Results obtained from the quantification of the color parameters and the oxide composition of the chert samples.

Samples	L	Oxides (%)							RGB	CCT (K)
	L	SiO2	CaO	Al2O3	K2O	Fe2O3	TiO2	SO3		
10067	1	93.3	0.1	5.8	0.8	0.0	0.0	0.0		5002
14615	2	74.8	1.4	13.0	8.1	2.0	0.2	0.4		5120
1743	3	96.0	1.9	0.0	0.3	1.3	0.0	0.2		4991
18176	4	94.6	0.0	5.3	0.0	0.1	0.0	0.0		4887
18185	5	88.7	0.5	7.2	2.9	0.3	0.1	0.2		4832
26360	3	95.1	0.1	4.4	0.1	0.2	0.0	0.0		4704
26407	6	95.0	1.4	0.0	1.7	1.3	0.0	0.1		4239
2835	7	97.6	0.0	2.3	0.0	0.1	0.0	0.0		5017
3295	3	91.6	0.3	7.2	0.6	0.2	0.0	0.0		4833
6343	8	95.1	0.0	4.7	0.0	0.0	0.0	0.0		5198
7182	9	98.1	1.7	0.0	0.0	0.0	0.0	0.0		5254
7186	3	95.8	0.0	4.1	0.1	0.0	0.0	0.0		4797
7191	10	83.3	0.8	11.4	3.1	1.2	0.0	0.1		4921
7195	9	70.4	0.8	25.6	0.6	2.4	0.1	0.2		4111
7209	10	94.0	0.0	5.7	0.0	0.2	0.0	0.0		4981
7212	11	52.0	0.4	44.2	2.1	1.1	0.0	0.0		5040
7219	12	100.0	0.0	0.0	0.0	0.0	0.0	0.0		4909
7606	3	79.2	10.1	8.5	1.7	0.4	0.0	0.1		4811
ARA3-18	13	96.9	0.9	0.0	1.3	0.5	0.1	0.0		4877
ASI1-43	14	82.3	0.5	10.5	5.3	1.3	0.1	0.0		3916
B3-18	15	72.2	1.5	14.0	9.7	2.2	0.1	0.0		4088
NMNH 111000	16	99.3	0.0	0.0	0.1	0.3	0.0	0.0		4153
NMNH 117737-58	17	67.9	2.3	21.6	4.9	2.9	0.2	0.0		5013
NMNH 117777-140	18	42.2	3.0	22.5	6.1	22.5	1.2	0.2		5003
NMNH 117787-35	19	93.0	1.3	4.8	0.2	0.8	0.0	0.0		4164
NMNH-98502-4	20	92.6	0.6	0.0	2.9	2.2	0.0	0.2		4776
S3	21	95.1	2.1	2.7	0.0	0.0	0.0	0.0		4726
V3-15	22	94.3	0.2	5.2	0.2	0.0	0.0	0.0		4867

L (Location): 1 Sants-Montjüic, Barcelona; 2 Pontils, Tarragona; 3 Área Metropolitana y Corredor de Henares, Madrid; 4 Sisante, Cuenca; 5 Sant Pere de Riudebitlles, Barcelona; 6 Lorca, Murcia; 7 Rubí, Barcelona; 8 L'Hospitalet de Llobregat, Barcelona; 9 Gràcia, Barcelona; 10 Les Borges Blanques, Lleida; 11 Dordogne, Francia; 12 Libourne, Francia; 13Arangas, Asturias; 14 Asiego, Asturias; 15 Ballota, Asturias; 16 Arizona, EEUU; 17 Northern Guarico-Lake Valencia Area, Venezuela; 18 Venezuela; 19 Montana, EEUU; 20 Texas, EEUU; 21 Sotres, Asturias; 22 Vidiago, Asturias.

Table 2: Pearson correlation between the CCT(K) parameter and the composition expressed in oxides of the chert samples.

Pearson	SiO_2	CaO	Al_2O_3	K_2O	Fe_2O_3	TiO_2	SO_3	SrO	ZrO_2
CCT(K)	0.7	-0.3	-0.5	-0.6	-0.8	-0.6	-0.1	0.4	-0.3

Conclusion

The color of the studied chert presents few variations among them since their chromatic coordinates are very close due to the fact that the elemental composition is similar in all of them. This color behavior in the chert studied so far seems to be a trend for others, regardless of their provenance and origin. It is likely that more pronounced differences between the chert can be obtained from reflectances measured in infrared regions, work that is planned to be carried out in the near future.

Acknowledgement

Spanish Ministry of Science and Innovation (No. PID2020-112832RB-I00). Spanish State Plan for R+D (No. HAR2017-82557-P). Smithsonian museum.

References

1. Luedtke BE (1992) An Archaeologist's Guide to Chert and Flint. Archaeological Research Tools 7. Institute of Archaeology, University of California, Los Angeles, California.

How to cite this article: María de U-Z, Pedro Á-L, Silvia B, Celia M.Characterization of Color and Composition in Chert for Grouping and Comparison. Glob J Arch & Anthropol. 2023; 13(2): 555858. DOI:10.19080/GJAA.2023.13.555858

2. Frederick CD, Ringstaff C (1994) Lithic resources at Fort Hood: Further investigations. In: Trierweiler WN (Ed.), Archaeological Investigations on 571 Prehistoric Sites at Fort Hood, Bell and Coryell Counties, Texas. Mariah Associates Inc.: Austin, Texas, USA.
3. CIE 1931 http://sciapps.sci-sim.com/CIE1931.html
4. www.nixsensor.com/free-color-converter/

How to cite this article: María de U-Z, Pedro Á-L, Silvia B, Celia M.Characterization of Color and Composition in Chert for Grouping and Comparison. Glob J Arch & Anthropol. 2023; 13(2): 555858. DOI:10.19080/GJAA.2023.13.555858