



X-ray investigation of graphic art

Investigação de arte gráfica por raios X

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ABSTRACT

X-rays produced by electron ionization provide an analytical tool that can assist investigations in the field of Artistic and Cultural Heritage. In this study, the technique of Energy Dispersive X-ray Fluorescence (EDXF) was employed to investigate collections of postcards from the 1960s produced in Brazil, London and Uruguay. The collections belong to private collections and were made available for analysis at the Radiation Spectroscopy and Spectrometry Laboratory of the Institute for Nuclear and Energy Research (IPEN). This technique is non-destructive and allows the identification of chemical elements present in the different chemical formulations used in the printing industries of each country in the process of preparing postcards. This information allows tracing their origin and identifying copies/fakes, which enables their cataloging and registration for exhibition, as well as providing subsidies for conservators and restorers regarding the preservation and storage of these artistic materials.

Keywords: X-Ray, Postcards.

RESUMO

Raios X produzidos pela ionização de elétrons fornecem uma ferramenta analítica que pode auxiliar investigações no âmbito do patrimônio Artístico e Cultural. Neste estudo, a técnica de Fluorescência de Raios X por Dispersão de Energia (FRXDE) foi empregada para investigar coleções de cartões postais da década de 1960 produzidos no Brasil, Londres e Uruguai. As coleções pertencem a acervos particulares e foram disponibilizadas para as análises no Laboratório de Espectroscopia e Espectrometria das Radiações do Instituto de Pesquisas Energéticas e Nucleares (IPEN). Esta técnica é não destrutiva e possibilita a identificação de elementos químicos presentes nas diferentes formulações químicas, empregadas nas indústrias gráficas de cada país, no processo de preparo dos postais. Essas informações permitem rastrear sua procedência e identificar cópias/falsificações, o que possibilita sua catalogação e registro para exposição, além de fornecer subsídios para conservadores e restauradores no que diz respeito à preservação e armazenamento desses materiais artísticos.

Palavras-chave: Raio-X, Cartões Postais.

1 INTRODUCTION

X-rays produced by electron ionization provide an analytical tool that can assist investigations in the field of Artistic and Cultural Heritage. In this study, the technique of Energy Dispersive X-ray Fluorescence (EDXF) was employed to investigate collections of postcards from the 1960s produced in Brazil, London and Uruguay. The collections belong to private collections and were made available for analysis at the Radiation Spectroscopy and Spectrometry Laboratory of the Institute for Nuclear and Energy Research



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The study of graphic arts, such as drawings, postcards, photographs, engravings, maps, cartographic charts, among others, is relevant to historical-artistic investigations insofar as it makes it possible to identify their production process, providing data that help to trace their origin as well as the identification of copies / forgeries. In this context, several non-destructive analytical techniques, such as Neutron Activation Analysis [1], PIXE [2], Raman [3], Infrared Spectroscopy [4], Energy Dispersive X-ray Fluorescence [5], which enable multielement analysis, have been used to characterize artistic graphic works from museum collections and collectors. The focus of the present investigation is directed to the multielemental investigation of postcard collections from different origins (Brazil, London and Uruguay), to obtain data that allow correlating their production process, with the time of manufacture and origin. This information provides a description that makes it possible to certify (trace) its origin and identify copies / forgeries, in addition to generating information that assists conservators and restorers with regard to the preservation and storage of these artistic materials.

The postcard is a communication object, i.e. intended for correspondence and widely used in the 19th and 20th centuries. It can be described as a simplification of the letter, whose purpose is to circulate by post without an envelope. The first mention of its creation dates back to 1840. It is a hand-colored postcard that was found at the beginning of the 20th century by a specialist investigating stamp collections.

In 2002 this postcard went to auction and sold for £31,750, which also emphasizes a rising market for collectors due to the appreciation of this type of artistic material [6].

Although there is no established format, the postcard is commonly made of thin cardboard in a rectangular shape, where one of its sides (front) has an illustration, while the other side (back) is reserved for the recipient's address, the sender's message and the postage stamp. Generally, the person who sends a postcard is someone who is traveling and wants to send news, as well as show the places visited. It is the illustrative feature that ennobles the postcard, as most of them are photos or drawings prepared by professional photographers and/or artists. In addition, it is usual to elaborate commemorative albums of postcards made to celebrate historical dates, albums elaborated to publicize tourist spots, works of art and iconic personalities.

In Brazil, the postcard was instituted in 1880 by the Minister of Agriculture, Commerce and Public Works Manuel Buarque de Macedo, by Decree No. 7695, which gave the monopoly of printing and editing postcards to the Brazilian Post Office, until in 1899 by means of another Federal Decree, the post office



released the production of cards leading to a significant increase in its production, popularization and diversification. At the beginning of the 1900s, with technological advances, industrialized photographic paper appears in the postcard format and publishers start producing their own series of postcards. Then came the first colorized cards, whose matrix was produced manually by the publishers, a task performed by the photographers themselves. In practice, the photographer painted a black and white photograph, generating an artistic production called "artistic photography", an artistic classification that was established by the photographers themselves at the time. The postcard was once one of the most used textual genres in everyday life for communication, as are today the posts made by social networks using the various applications available.

In this study, the Energy Dispersive X-ray Fluorescence (EDXRF) technique [5,7] was employed in the multielement investigation of postcard albums produced in Brazil, Uruguay and London in the 1960s. These albums belong to private collections and were made available for analysis at the Laboratory of Radiation Spectroscopy and Spectrometry (LEER) of the Institute for Nuclear and Energy Research (IPEN).

2 OBJECTIVE

The purpose of these analyses is to identify the chemical elements present in the printing process of the postcards used in the printers of origin in each country. The information obtained allows identify whether different chemical formulations were employed, based on their multi-elemental characterization.

3 METHODOLOGY

The study material consists of 9 postcard albums from different graphic origins (4 Brazil, 3 Uruguay and 2 London). For each album (average of 10 postcards/album) several different points were analyzed; usually the choice of the points of analysis is directly related to the colors and their respective intensity (lighter or darker tone) that make up each postcard.

The XRF measurements were performed using a compact and portable XRF spectrometer from Amptek®. This instrument consists of an X-ray tube with silver (Ag) target, Silicon Drift XR-100SDD detector (25 mm² x 500 μm) with Beryllium window (12.5 μm), coupled to a pre-amplifier, a digital pulse processor and multichannel. The excitation condition was set by 5 μA and 30 kV with a counting time of 180 s. Due to the portability of the equipment each postcard was positioned in front of the "X-ray tube - detector" assembly at a distance of 2 mm. The spectra were obtained using dedicated software [8] and the



spectral analysis using WinQxas software [9], allowing to identify and correlate the quantities of the elements in the sample (in this case, the postcard).

4 DEVELOPMENT

To visualize the analyses, a sample of a postcard (depending on the origin) and the spectral analyses are presented in Figures 1 to 6 for Brazil, London and Uruguay, respectively. These analyses show the differences in composition and the variation in intensity of some elements.

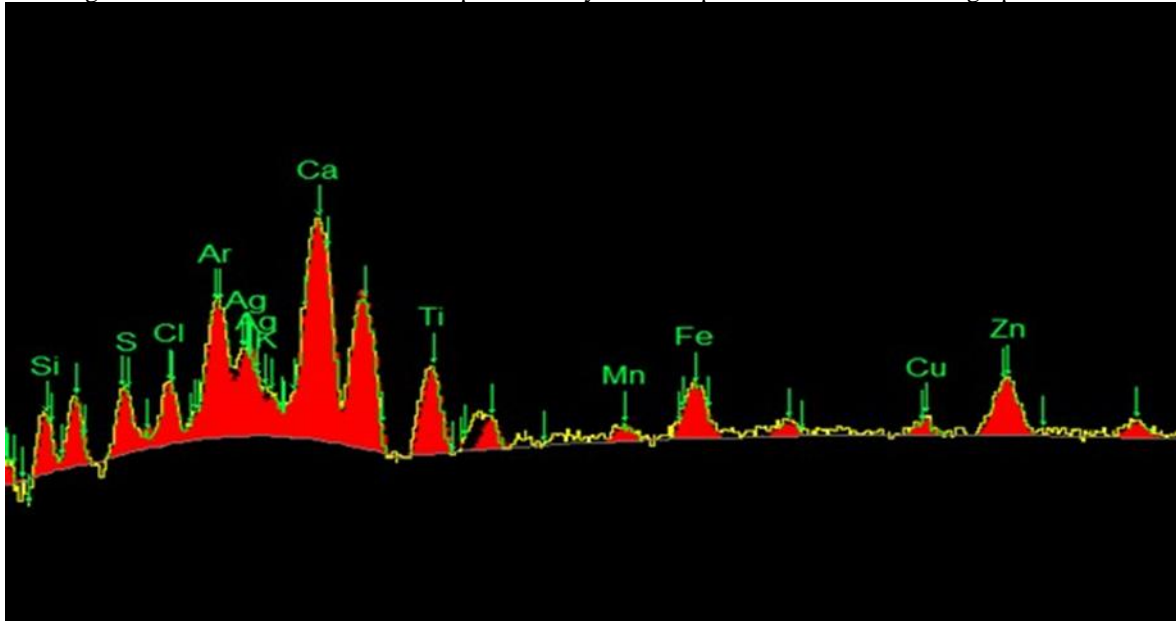
Figure 1 - Postcard of Brazil's graphic origin



Source: Author, 2023.



Figure 2 - Visualization of the XRF spectral analysis of the postcard from the Brazil graphic album



Source: Author, 2023.

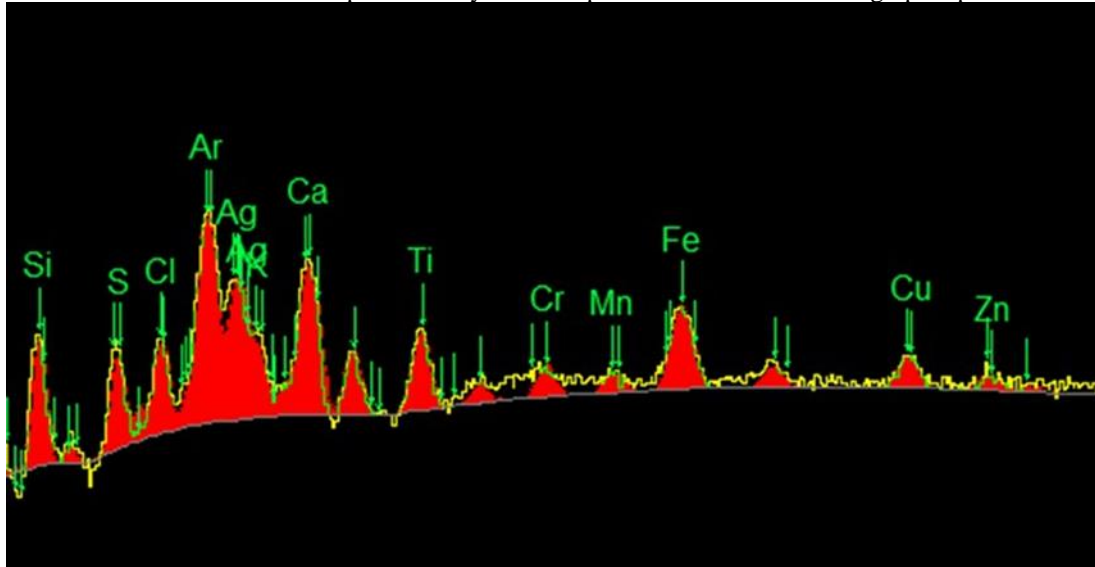
Figure 3 - Postcard of graphic provenance from London



Source: Author, 2023.



Figure 4 - Visualization of the XRF spectral analysis of the postcard from the London graphic provenance album



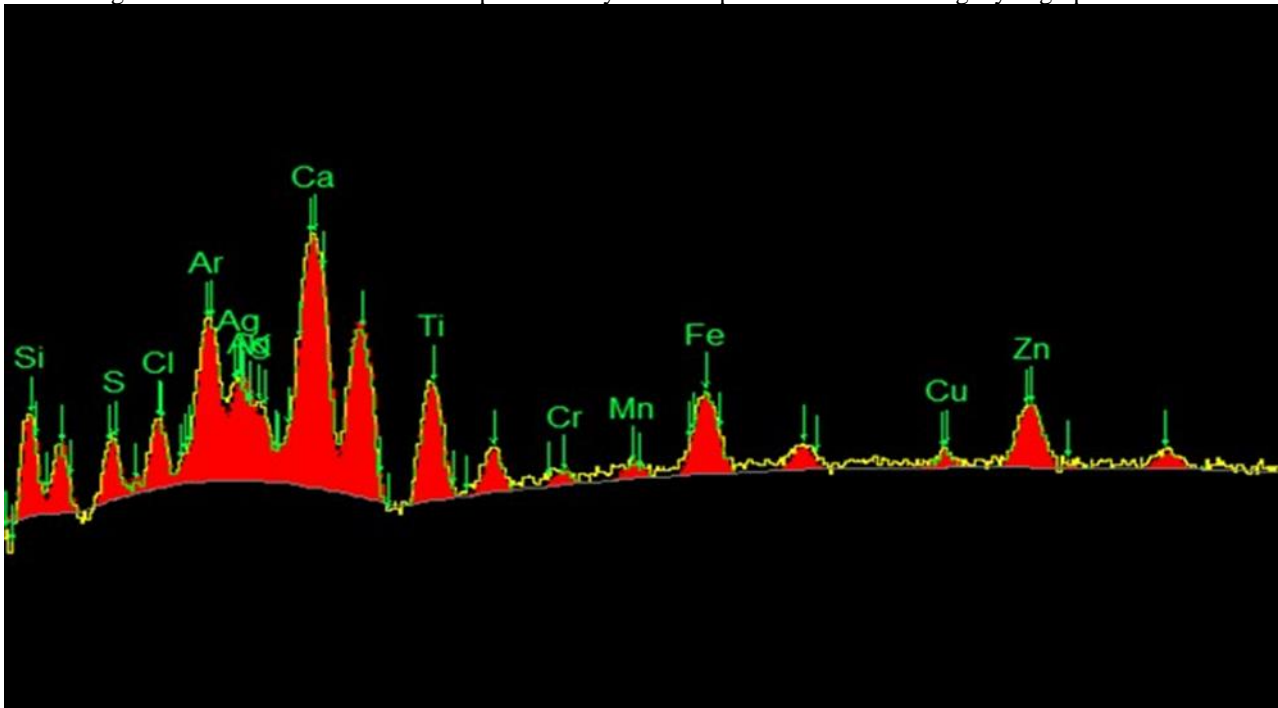
Source: Author, 2023.

Figure 5 - Postcard with graphic provenance from Uruguay



Source: Author, 2023.

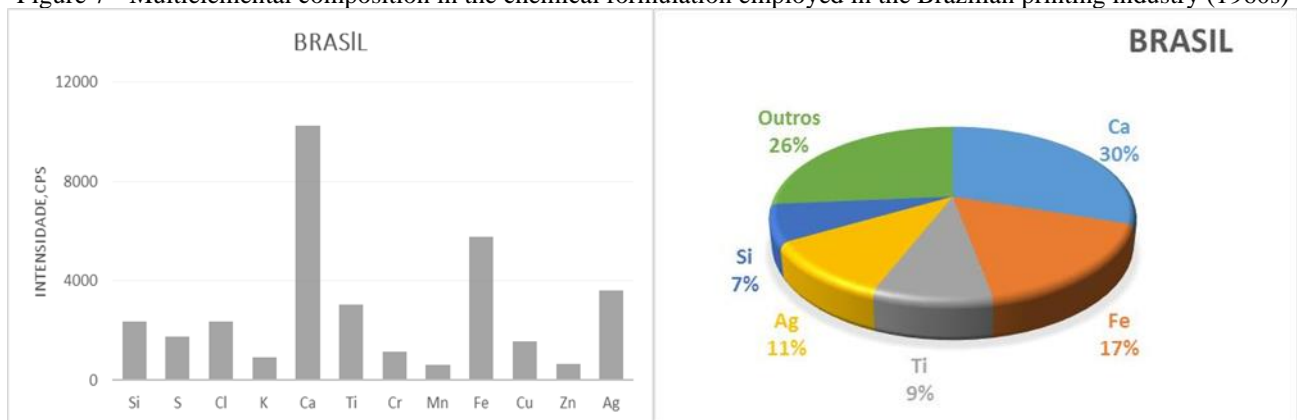
Figure 6- Visualization of the XRF spectral analysis of the postcard from the Uruguayan graphic album



Source: Author, 2023.

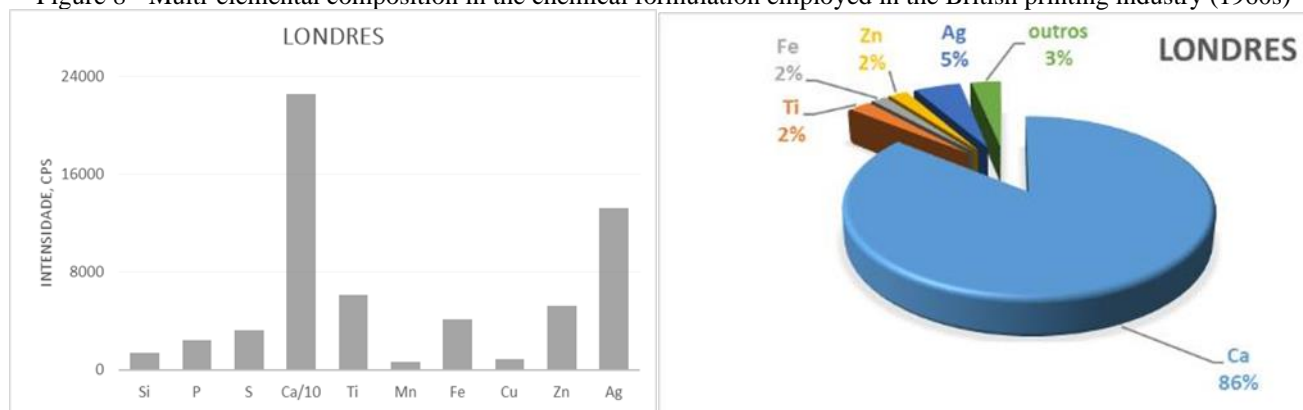
Figures 7, 8 and 9 show the qualitative and quantitative assessments of the chemical elements present in the different chemical formulations used in the printing industries of each country in the postcard preparation process.

Figure 7 - Multielemental composition in the chemical formulation employed in the Brazilian printing industry (1960s)



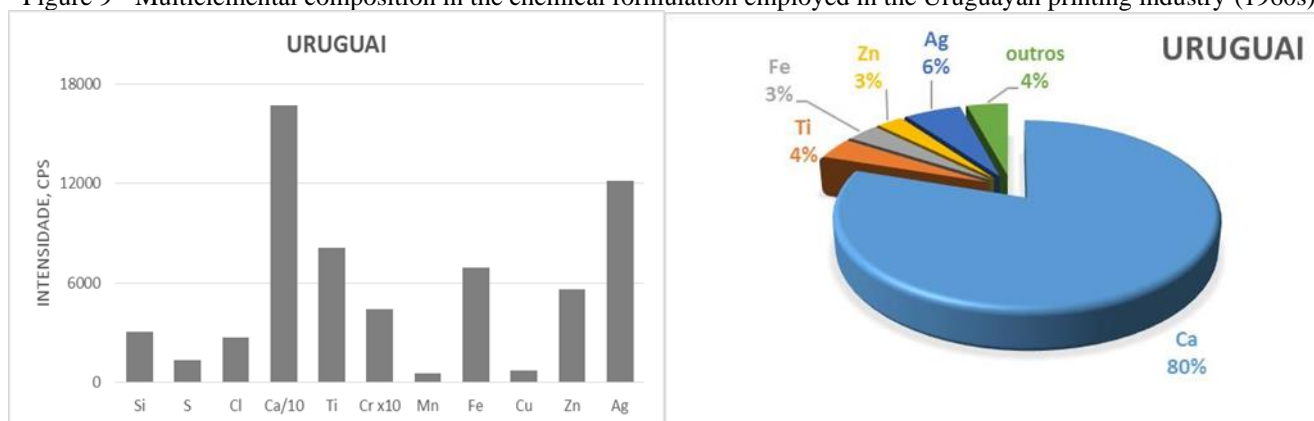
Source: Author, 2023.

Figure 8 - Multi-elemental composition in the chemical formulation employed in the British printing industry (1960s)



Source: Author, 2023.

Figure 9 - Multielemental composition in the chemical formulation employed in the Uruguayan printing industry (1960s)



Source: Author, 2023.

A systematic behavior was observed for all albums depending on the origin. In the albums of national origin there is a greater number of chemical elements in the chemical formulations with high intensity for calcium - Ca (~30%) and iron - Fe (15% to 17%). However, when the comparison is made with the other printers, the high intensity of Ca is maintained, but on a much larger scale (factor of the order of 2 to 3 times), while the intensity of Fe decreases; specifically, in one of the British collections the presence of Fe is of the order of 0.5%, and in some postcards it is below the detection capacity of the FRX methodology. The presence of silver (Ag) and titanium (Ti) are also present in all postcard compositions regardless of origin, but in greater intensity in national albums and show the use of industrialized photographic paper in the postcard format.

5 FINAL CONSIDERATIONS

The information obtained regarding the qualitative and quantitative evaluations of the chemical elements present in the chemical formulations (that is, in the process of preparing the postcards), employed in the printing industries of each country and correlated with their printing date, show differences allowing



the generation of a database that can assist historians and curators in cataloging postcard albums in museums, which is essential for dissemination and presentation in exhibitions. In addition, these data can assist graphic artists with data on printing processes and, for conservators, assist in material preservation as well as expand knowledge in Art History, and for collectors, certification and valorization of artistic material.



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