Conservation and protectionof the Damaged Archaeological Glass by the Explosion "A case study"

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Abstract:

In 2014, an explosion happened in the Cairo Security Directorate building in front of the Museum of Islamic Art, causing damage to some displayed objects, especially the glass ones. The explosion caused overlapof the archaeological glass pieces with the non-archaeological glass pieces which are attributed to the showcases and windows of the museum. In addition, the non-damaged glass monuments were unsafe and needed to be protected to move to a safe place.

The first step for the conservation of the non-damaged glass monuments was to pack and move the objects to the store. On the other hand, the damaged glass objects were collected carefully then put in boxes and moved to the conservation lap to separate the archaeological pieces away from non-archaeological pieces depending on the previous documentation.

The restoration process of the damaged objectshas been started by documentation,examination by SEM and LM, analysis by EDX and XRF, cleaning, assembling,and finally completion of the process.This Paper is a case study for the restoration of damaged glass objects.

Key words: Archaeology, Damaged glass,Explosion, Restoration,Protection,Conservation.

1. Introduction

Protecting cultural heritage in times of conflict should not be understood as only the protection of material cultural heritage. When wars begin, cultural heritage experts focus on protecting movable or immovable cultural property from damage. This task is obviously quite important for preserving collective identity, but is not the only one. The cultural heritage concept has expanded considerably in recent decades, and nowadays intangible cultural heritage is also considered relevant in representing a community's identity. In this sense, traditional manifestations and also historic buildings, archaeological objects and others constitute the essence of the cultural heritage, so why not also protect this new category of cultural heritage during times of conflict? (Marcela, 2012)

More and more, cultural heritage is seen as an instrument for peace and reconciliation. Its protection and conservation can play a key role in rebuilding societies and overcoming the sense of loss and displacement caused by conflict (Mounir, 2012)

1.1 The situation:

on 24thof January, an explosion near the museum of Islamic art in Cairo Egypt has happenedwhich caused damage of 170 archaeological objects, including 52 glass objects.

There were some problems in the way of displaying the pieces in the museum lead to increase the damage to glass objects, such as putting a huge metal lamp over a showcase of the glass objects, which caused a crash of the glass objects and the glass showcase when it separated from the ceiling. [Fig. (1), a]. Also, the presence of solid objects with glass objects in one showcase [Fig. (1), b] and putting a glass objects showcase in front of the main door of the museum [Fig. (1), c] (Hamdy H.M, 2018).

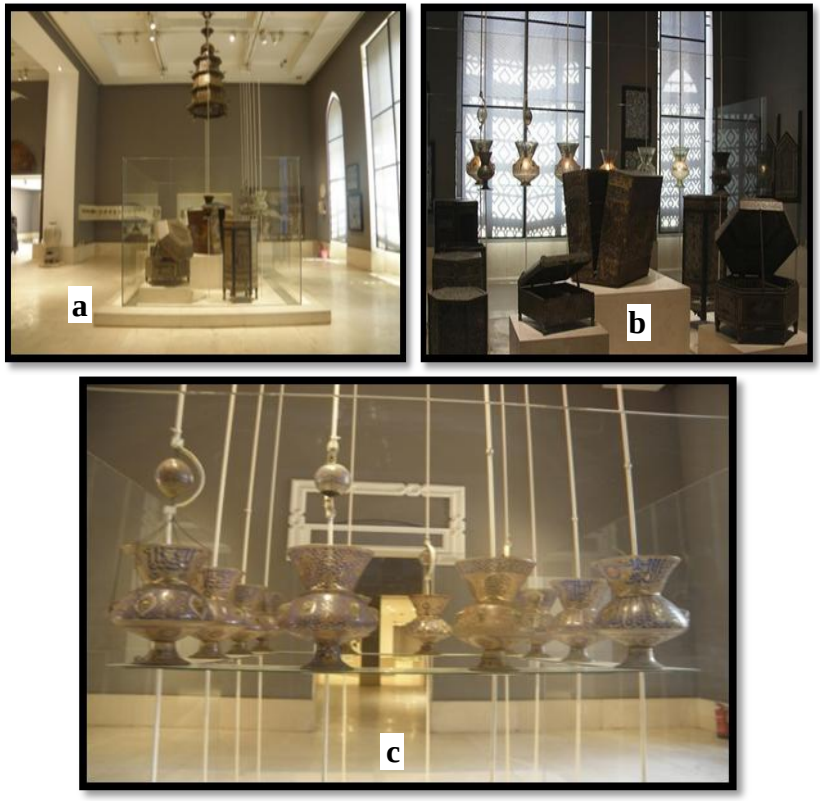


Fig. (1) problems in the way of the displaying of monuments.

After the explosion, non-damaged glass monuments were unsafe [Fig. (2), a] so the crew had to pack them by bubble sponge and polyethylene and moved them to the warehouse [Fig. (2), b,c] while the damaged objects were transferred to the conservation Lab.

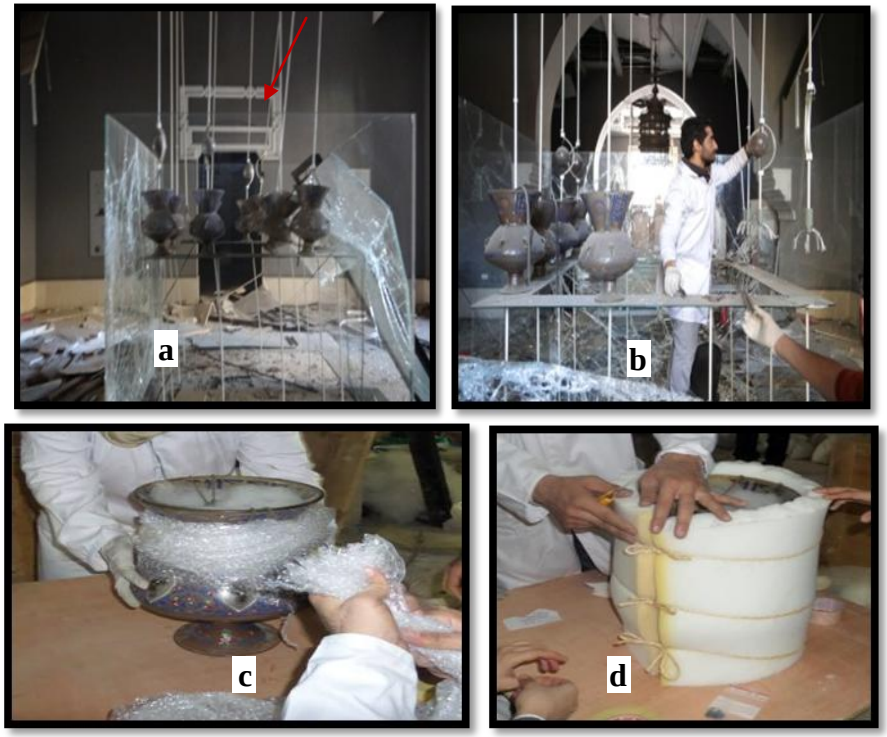


Fig. (2)the packing process of the non-damaged object.

As a result of the explosion, the archaeological glass piecesmixed with the non-archaeological glass pieces [Fig. (3), a], so all pieces weresorted in boxes and transferred to the conservation Lab [Fig. (3), b, c, d].

Fig. (3)Sorting of archaeological and non-archaeological pieces.

The sorting processbegan in steps.First, to separate every object away from the other depending on the decoration, thickness, break position and colour of glass pieces [Fig. (4), a].Second, contacting the museum information centre to identify the numbers of the objects in each showcase and to obtain the pictures of objects before the explosion [Fig. (4), b].

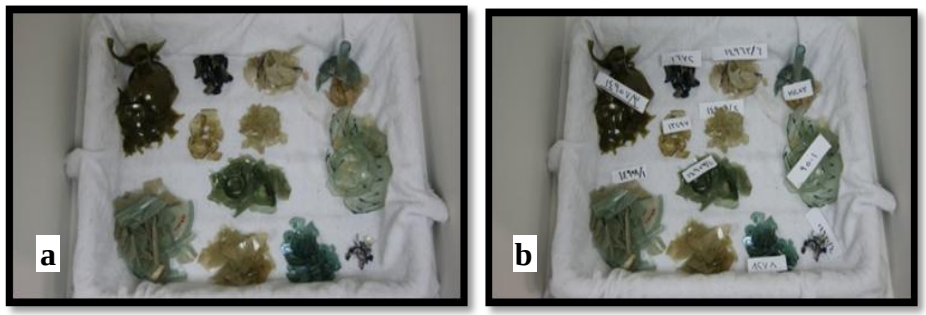


Fig. (4)Classification of every object separately.

The number of the damaged glass objects were 52 pieces, but the restoration stages in this paper is for one case as an example. It is a glass ball (No. 20083), Which was used in the decoration of mosques, dating to the Mamluk Islamic Age. It was decorated with blue and brown Mina [Fig. (5), a], It was 13.5cm in height and 11.2cm in diameter. Ithad been crashed to more than 60 pieces [Fig. (5), b].

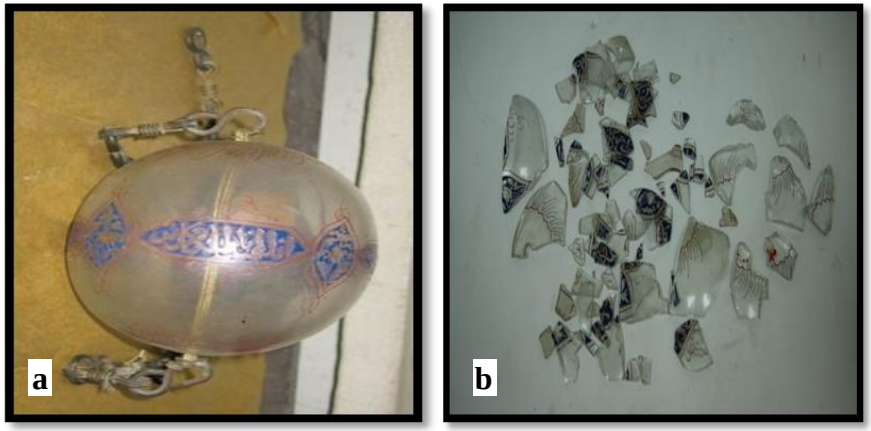


Fig. (5)The case before and after the explosion.

The cleaning phase was just to remove dust. The basic stage of the restoration of the object is the assembling step. The pieces were assembled depending on the decoration, thickness and break position. Firstly, the base of the object was assembled, [Fig. (6)] then the body. It was first assembled using transparent tape then Araldite2020.
There were many missingpieces in different parts of the body that made the object weak, and it was completed using Araldite 2020. The assembling step was done with the completion step. The last missing part was made separately then installed in its place.Polishing was done earlier using Araldite 2020 followed by cutting and installing the pieces. [Fig. (7) h : p].

Fig. (6)The assemblingofthe object.

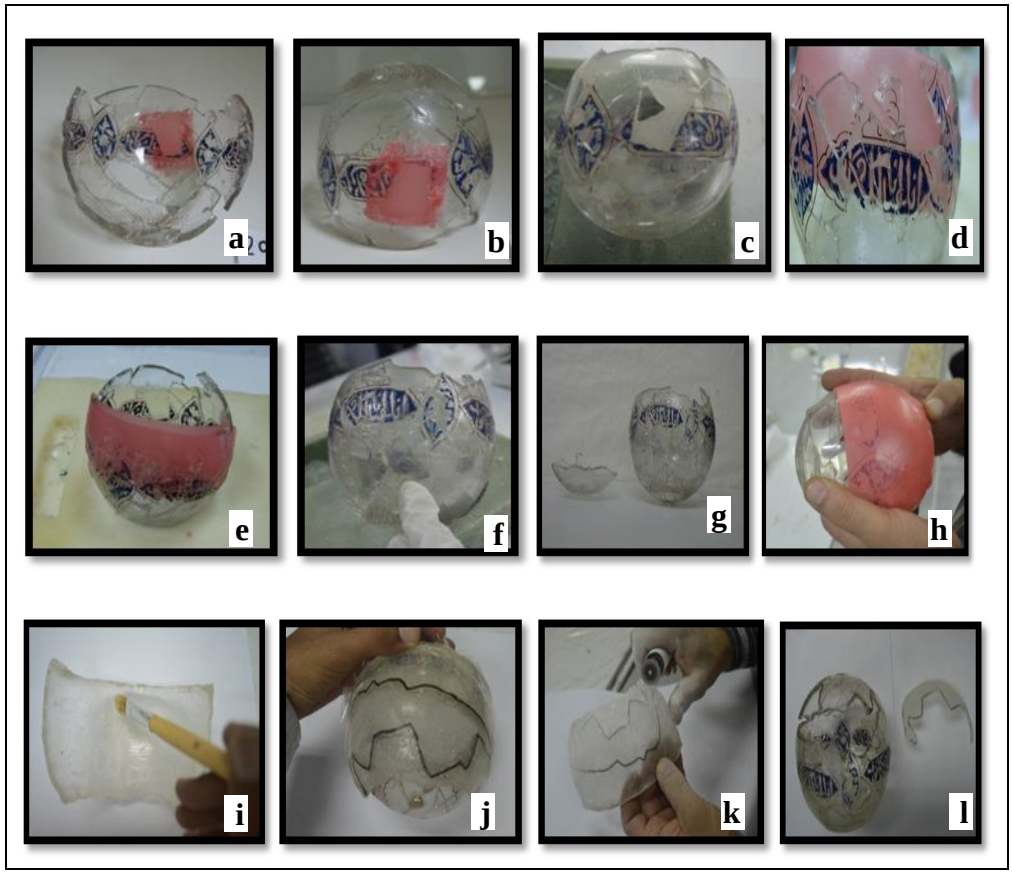


Fig. (7)The completion steps of the object.

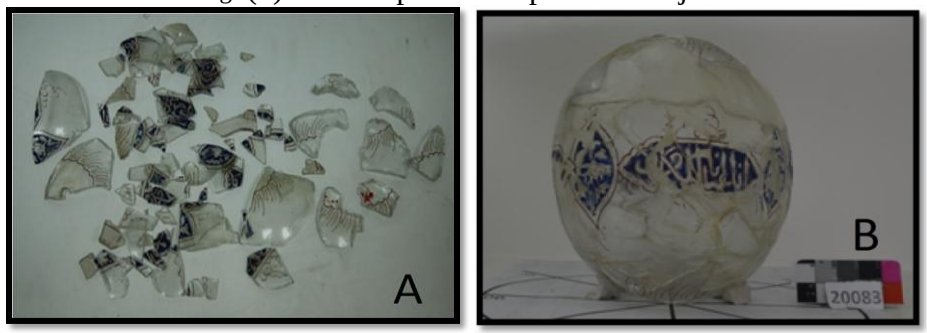


Fig. (8) The object before and after conservation

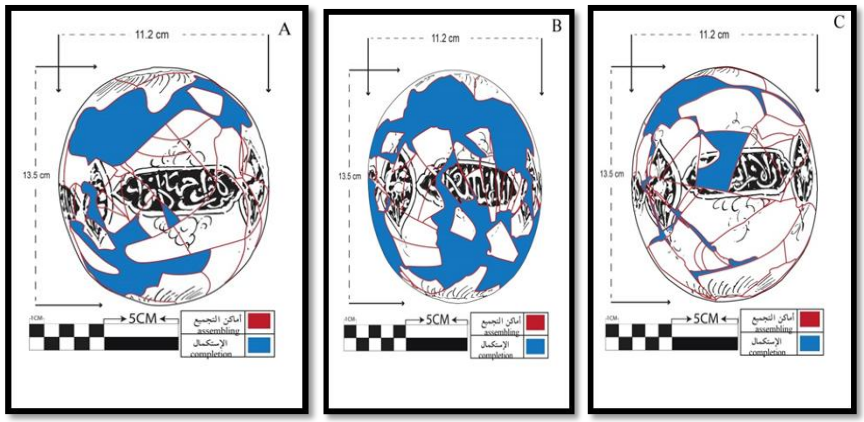


Fig. (9) The object by AutoCAD documentation after restoration

2. Material and Methods:

The examination and analysis were performed on a glass piece with blue and brown Mina.

2.1 Scanning Electron Microscopy- Energy dispersive X-ray spectroscopy (SEM-EDX)

The SEM-EDX was used to determine the micro textural and micro chemical features of the glass. The SEM-EDX was performed with K550X scanning electron microscope equipped with an England microanalysis system(kV:30.0, Tilt:0.0, Take-off:39.0, DetTypeSDD Apollo 40, Res:132, Amp.T:12.8, FS : 505, Lsec : 10).

2.2 X- ray fluorescence (XRF)

X-Ray Fluorescence was used to identify the elements of glass, blue and brown Mina. X-Ray Fluorescence was used to identify the elements in glass, blue and red Mina.

3. Results and Discussion

"Dealing with crises" First Aid to Cultural Heritage in Times of Conflict Specially the archaeological glass aims to create a critical mass of Professionals who can intervene effectively to secure cultural heritage in such times of conflict, and who can work with other actors to integrate this protection into overall planning for peace and recovery (Simon. L&Cynthia. R, 2012)

Problems of museum display that helped to exacerbate the crisis The museum's display of archaeological glass is mixed with other types of archaeological heavy solid artifacts such as archaeological metals, it should be separated in displaying (Thickett D & Lee L.R 2004)

The need for full documentation of archaeological artifacts in the museum which will mainly assist in restoration and protection if necessary (Efstratios S & Fabio R 2016) .

Either Mina samples showed the typical amorphous background of glasses in which no crystalline phase is present. This fact could also indicate that no industrial mistakes were induced in the pyre stage(Freestone et al., 2008).

Scanning Electron Microscopy- Energy dispersive X-ray spectroscopy (SEM-EDX)

Regularly, glass production process involves melting Silica constituent (e.g., quartz sand, crushed quartz pebbles) with a fluxing agent (e.g., potassium or sodium, Alumina oxides) and with additional calcium-rich material, such as limestone, seashells or marble powder (Jackson et al., 1991 &Hamad, 2014)

The stability is due to the presence of CaO, increasing the coupling of the vibrational modes of the silica nonbridging oxygen modifier bonds to the bridging of the Si–O–Si network (Abd-Allah 2000&Davison, 2003).

Table 1: Shows chemical composition of the samples with EDX analysis.

Elemen-ts- wt%	Na	Mg	Al	Si	Cl	K	Ca	Mn	Fe	Pb	Zn	Cr	P
Glass	9	3.82	1.69	70.24	0.78	4.21	9.51	0.76	-	-	-	-	-
Red Mina	1.05	-	0.35	20.88	-	2.81	3.37	-	18.72	31.99	-	-	2.54
Blue Mina	2.68	-	4.09	22.10	-	0.85	0.52	-	0.35	44.45	4.27	0.70	0.17

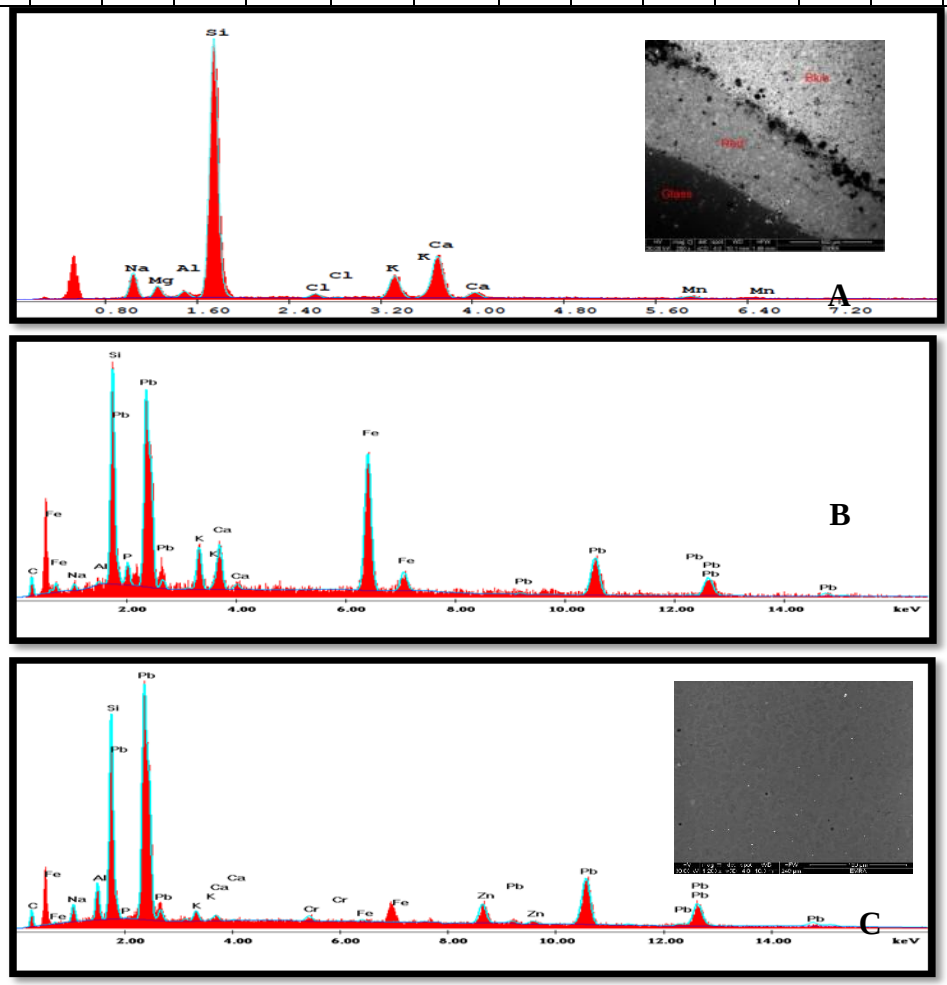


Fig. (10) SEM, EDX (mag 200x): glass (a), red Mina (b) and blue Mina (c).

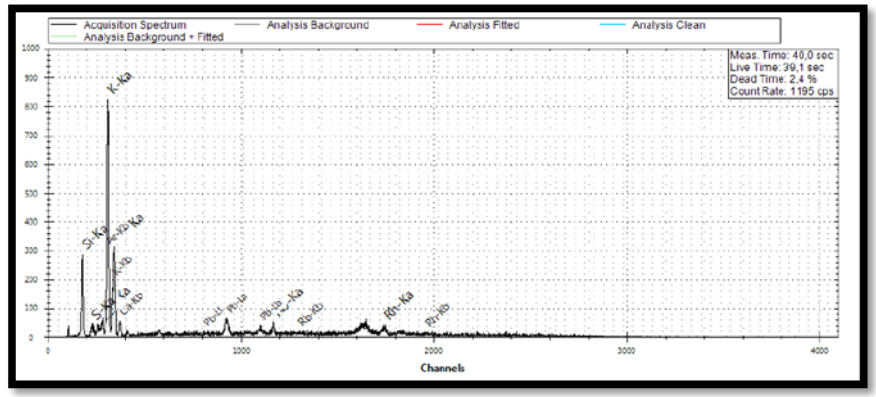
The Fluorescence Spectroscopy (XRF)

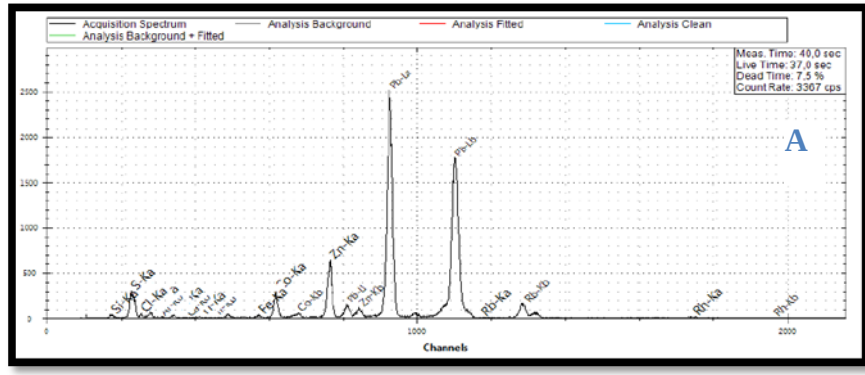
The main component is SiO_2, the glass network-forming oxide, these glass pieces can be classified as soda– lime–silica (Na_2O–CaO–SiO_2) glass, the common type of ancient glass for more years(Ferna´ndez et al., 2003&Scholze et al., 1975).

Iron Oxide and Chromium Oxidewere used to make brown Mena; Cobalt Oxide was used to made blue Mena (Rasha T. Hamad, 2014).

Table 2: Shows chemical composition of the samples obtained by (XRF).

Elements- wt%	Si	Cl	K	Ca	Fe	Pb	S	Cu	Zn	Co	Ti
Glass	72.7	-	16.54	4.02	-	1.78	5.05	-	-	-	-
Red Mina	63.93	-	0.03	0.01	0.65	11.17	24.19	0.02	-	-	-
Blue Mina	41.29	5.77	0.49	1.17	0.07	8.61	40.47	-	0.97	0.7	0.18





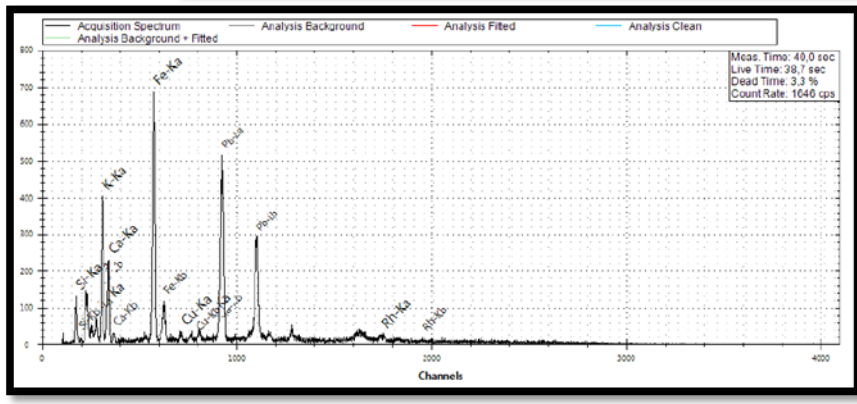


Fig. (11) Shows samples glass(a), red Mina (b) and blue Mina analysis by XRF

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4. Conclusion

Crisis Like explosion may happened in any times around the world, no one can stop or control it. Therefore, the archaeological glass should be displayed in showcase away from the heavy artefacts. The modern digital documentation (MDD) should be used for the documentation process for each archaeological object.The damaged objects moved to

conservation lab while the non-damaged one backed and moved to the museum stocks. The archaeological fragment separated from the non-archaeological one due to the previous documentation.

The restoration process illustrated here is for one case as an example, it shows a glass ball (No. 20083), that has been crashed to more than 60 fragments because of the explosion. The cleaning phase was just to remove dust. The basic stage of the restoration of the object is the assembling step, the assembling step was done with the completion step. The examination and analyses were performed on a glass piece with blue and brown Mina and then inserted into the object. The SEM-EDX and XRF were used to study the object. The main component is SiO_2, the glass network-forming oxide, such glass pieces can be classified as (Na_2O-K_2O–CaO–SiO_2) glass. Iron Oxide and Chromium Oxide were used to colour brown Mina, while Cobalt Oxide was used to colour blue Mina.

Acknowledgments

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