Centre for Archaeology Report

Identification of Garnet Gemstones from Buttermarket Cemetery, Ipswich

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Summary

Small fragments of a hard, red coloured material were found as part of a bag collection in a 7th century female burial at Buttermarket cemetery, Ipswich. These fragments were analysed using XRF spectrometry and found to be garnet gemstones.

Keywords

Gemstone, Buttermarket, Early Medieval

Introduction

A number of fragments of a hard, red coloured material were recovered from the 7th century inhumation cemetery at Buttermarket, Ipswich. The fragments formed part of a bag collection in grave 4275; a female burial dating to the second half of the 7th century. The majority of the fragments were roughly spherical in shape but two had been cut or formed into thin slices with an elaborate silhouette, probably for use in jewellery. The objects were thought to be either garnet gemstones or red coloured glass and analysis was requested to distinguish between the two materials.

Method

XRF analysis was used to determine the composition of the fragments. This technique is rapid and causes no damage to the samples. Analysis was conducted using conditions of 40keV and approximately 300μA. The results can be presented quantitatively as a table of concentrations, in weight percent, for each oxide present. However as the technique analyses the surface of the sample, which can be weathered and contaminated with soil, the results must be interpreted with caution.

Results

Analysis of the Buttermarket fragments showed that all of the samples, including those cut and shaped, shared a similar composition that was rich in aluminium, iron and magnesium oxides. They did not contain any copper or lead oxides. The compositions of the samples analysed are given in table 1.

Table 1: Results of XRF Analyses of Buttermarket Samples

Sample	MgO	Al_2O_3	SiO_2	CaO	TiO_2	Cr_2O_3	MnO	FeO
v	18.5	17.4	40.6	4.1	0.6	3.1	0.6	15.0
dd	19.9	18.6	38.6	4.0	0.6	2.9	0.5	14.9
s	21.5	18.2	39.0	3.4	0.7	2.6	0.6	14.0
x	19.3	18.6	41.4	1.1	0.5	2.6	0.5	15.9
r	4.0	16.0	29.4	0.7	0.1	0.1	0.9	48.8
u	18.9	17.2	38.2	3.9	0.6	4.0	0.6	16.6
z	21.7	18.4	38.9	3.6	0.7	2.9	0.5	13.3

Discussion and Conclusions

Red glass of this period is usually coloured by small crystals of copper oxide, cuprite, and / or tiny droplets of copper metal. There is also usually some lead oxide present and typical compositions for red glass of this period are given in table 2. The data on red glass from Hamwic (sample numbers preceded by an H) is from literature sources (Hunter et al, 1998) and was obtained using ICP analysis. Due to chemical reactions occurring during sample preparation with this technique the amount of silica present cannot be measured and is therefore calculated by difference. All of the glasses contain only small amounts of iron, magnesium and aluminium oxides.

Table 2: Composition of Red Glasses from Hamwic, from Hunter et al, 1998

Sample	MgO	Al_2O_3	SiO_2	CaO	TiO_2	MnO	FeO	Na_2O	PbO	CuO
H11/158	1.98	2.21	61.45	8.58	0.13	0.37	1.43	12.22	4.97	0.97
H24/502	1.11	3.85	66.55	9.05	0.25	0.42	1.66	11.28	0.67	0.37
H26/770	1.23	3.28	67.88	8.22	-	0.52	1.30	12.99	1.16	0.14
H22/3	0.70	2.74	70.81	7.26	0.11	0.37	0.77	15.34	0.33	0.05
H99/52	0.92	3.30	63.57	6.25	0.20	0.38	1.44	14.89	4.86	0.55

Comparison of the data in tables 1 and 2 indicates that the Buttermarket samples are clearly not red glass. However the composition of the samples is consistent with garnets of the pyralspite series: a continuous mineral series with varying proportions of iron and magnesium between the end members pyrope $Mg_3Al_2(SiO_4)_3$ and almandine $Fe_3Al_2(SiO_4)_3$. The

compositions of typical garnets of this series are given in table 3 (Deer et al, 1992). Pyrope garnets with Cr_2O_3 contents of 3-8% are common, as Cr can substitute for Al in the structure, and several of the samples analysed contain 2.5wt% Cr_2O_3 or more. The colour of garnets is extremely variable but is mainly controlled by the amounts of Fe, Mn and Cr present. Pyrope is typically a pinkish red with the chrome type variety having a greenish violet to purplish hue. Almandine is commonly deep red to brownish black. Garnets with a ratio of approximately two to one of pyrope to alamandine are popular as gemstones and typically have a red-lavender colour. All of the garnets analysed are of this category with the exception of sample “r”, which is predominantly almandine.

Table 3: Typical Compositions of garnets, from Deer et al, 1992

Sample	**MgO**	**Al_2O_3**	**SiO_2**	**CaO**	**TiO_2**	**Cr_2O_3**	**MnO**	**FeO**	**Fe_2O_3**
Alamandine	0.90	21.4	36.7	9.02	0.75	-	1.14	29.9	-
Pyrope	19.60	21.83	41.33	4.40	0.28	1.73	0.44	9.00	1.44

References

Deer, W A, Howie, R A and Zussman, J 1992 *The Rock-Forming Minerals*. Harlow: Longman Publishers.

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