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Beads for Nubian monks: An interdisciplinary assessment of a Ghazali find

Introduction

By the Christian Period (ca. AD 641-1400), Nubia was divided into three regional kingdoms: Nobadia in Lower Nubia, Makuria in Upper Nubia and Alwa (Alodia) with its northern boundary above the Fifth Nile Cataract. By the early 600s AD, Nobadia and Makuria were united under the Makurian king. Throughout the Christian Period, numerous churches and monasteries were built in Nubia. They ranged in size from small to sprawling establishments. One of the monasteries has been excavated at Ghazali, located between the Third and Fourth Nile Cataracts, in Wadi Abu Dom, at a distance of about 15 km from the river bank. This was the place where the Makurians built a monastery of the size of St. Catherine monastery in Sinai, Egypt.

In 2012, the Polish Centre of Archaeology of the University of Warsaw (PCMA UW) and the National Corporation of Antiquities and Museums (NCAM) decided to carry out joint excavations as the Ghazali Archaeological Site Presentation Project (GASP).[1] The site of the project contains a medieval monastery, a neighboring settlement, the surrounding cemeteries and iron production sites (fig.1 & colour fig. I-A).

One hundred and twenty-six beads associated with two pendants were found at Ghazali during the 2015 excavation season and registered under the number Gh.050. The beads were found in a hole in the western *mastaba*/bench in one of the six dormitory cells of the monastery, Room 70 (colour figs. I-B, C). Many of the beads were found on a string in their original arrangement. In general, a few yellow and one blue glass beads alternated with several ostrich eggshell ones (fig.1 & colour figs. I-C, D). The thicker string fragments were most probably attached to a fiber plaited case that holds resin pieces. The string might have also gone through the central hole of a metal pendant.

A comparative morphological study allows to date the find to the period between the 10th and 12th century AD. Additionally, two bead samples were investigated using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and the origin of the glass used in their production could be roughly established through chemical compositional analysis.

1 Obłuski et al. 2015; 2017

Morphological description of finds

Fiber plaited case pendant

The fiber plaited case pendant, now broken, was originally globular in shape (fig.1 & colour fig. I-E). The case measures about 15 mm in diameter. It contained a few pieces of resin. No parallel for the resin hold in a fiber plaited case has yet been discovered.

Ostrich eggshell beads

Ninety-nine beads were made of ostrich eggshell (fig.1 & colour fig. I-F). These are perfectly shaped into disc cylinders and measure from 4.3 to 5.8 mm in diameter and from 1.4 to 1.7 mm in thickness. They have regular perforation in the shape of a short cylinder measuring from 1.0 to 1.3 mm in diameter. Ostrich eggshell was one of the most common materials used in Nubian bead assemblages since the Paleolithic, including Medieval collections.[2]

Metal pendant

The hollow copper-alloy pendant consisting of a main perforated biconical part ends with a cylinder to which a cross of folded metal sheet is attached (fig.1 & colour fig. I-J). Short collars are set around the hole on both sides. The pendant measures 9.3 mm in thickness, 9.8 mm in width, and 18.8 mm in length. The hole diameter in biconical part is 1.7 mm.

The style and technique of manufacture of the pendant, with short collars set around hole openings, remind a cross found in Meinarti.[3] The cross comes

2 E.g., Then-Obłuska 2013

3 Adams 2001: Fig. 16, Pl. d - object 799

from level 11a, which was dated to the Classic Christian period, late 10th to 11th century AD. In terms of technique, the Ghazali example can also be compared with a silver pendant cross from Qasr Ibrim.[4]

Stone beads

Four long tubular beads were made of unidentified black stone (fig.1 & colour fig. I-G). The beads measure 2.5 mm in diameter, 4 mm in length and 0.8 mm in hole diameter. They have not yet been paralleled.

Glass beads

All glass beads, yellow (Mustard Gold 2.5Y 6/8)[5] with transparent colourless inclusion, and blue (Medium Blue 5.0PB 3/6), were sections of drawn glass tubes. Some segments were simply broken off and left unworked with rough cut ends, some have their ends heat-finished, other were heat-rounded.

Three yellow beads are broken off pieces of drawn glass tube (fig.1 & colour fig. I-H.1, 2). They measure between 6.0 and 6.8 mm in diameter, between 4.8 and 6.1 mm in thickness, and between 1.4 and 1.6 in hole diameter.

Fourteen and a half beads were made of yellow glass. They are sections of drawn tube that have their ends heat-finished (fig.1 & colour figs. I-H.3,4) or the sections were heat-rounded (fig.1 & colour fig. I-H.5). The beads measure from 5.5 to 7.5 mm in diameter, from 4.2 to 6.1 mm in thickness, and from 1.3 to 1.7 mm in hole diameter.

Two blue beads were made of drawn and rounded glass and they are slightly flattened (fig.1 & colour fig. I-I. 1,2). They measure 7.2x5.8 mm and 6.2x5.4 mm in diameter, 7.0 and 5.3 mm in thickness, and 1.5 mm in hole diameter.

Another two blue beads are sections of a drawn tube (fig.1 & colour fig. I-I.3). They have their ends heat-finished. The short cylinder measures 6.2 mm in diameter, 3.4 mm in thickness, and 1.3 mm in hole diameter. The long one measures 5.0 mm in diameter, 6.9 mm in thickness and 1.4 mm in hole diameter.

Beads similar to Ghazali drawn and rounded yellow glass specimens were found originally threaded on a string at Abkanarti Grave T 76. They were associated by ostrich eggshell and folded mosaic glass beads.[6] The latter ones belong to the Islamic type that has been dated to the 12th century AD.[7] Thus, it is probable that the Ghazali find might be dated likewise. Other similar yellow beads are known from one of Christian Dongola houses at Site P.[8]

4 Adams 2010: Pl. 37f, reg. no. 86/856
5 Munsell Bead Color Book
6 Museo Arqueológico Nacional, Madrid, MAN 1980.101.1014a – personal observation
7 Dubin 2009: Bead Table no. 560

Chemistry of glass beads

Drawn and rounded glass beads generally used to be associated with South Asian tradition of bead production, and as such have been called Indo-Pacific.[9] However, the chemical compositional analysis of the beads from the Red Sea port Quseir al-Qadim in Egypt reveals that it was not always true in the Medieval times.[10]

In an attempt to identify the origin of the glass used to manufacture the beads found in Ghazali, two glass samples, a blue (fig.1 & colour fig. I-I.1) and a yellow one (fig.1 & colour fig. I-H.5) were investigated at the Biological and Chemical Research Centre of the University of Warsaw, Poland, using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). The aim was to evaluate the elemental composition of the glass beads by means of a sensitive and minimally destructive instrumental method, allowing for maximum protection of the investigated items. The analysis confirmed that both specimens were composed of a plant-ash-soda–low-alumina glass type, v-Na–Ca.

The glass has high potash and magnesia concentrations (>1.5%) that are usually associated with the use of soda plant ashes (Table 1). Toward the end of the 1st millennium AD, the use of natron declined[11] and a return to plant ash occurred: by the 8th century AD, it became the dominant glass type throughout the Middle East and the Mediterranean and is called generally Islamic glass.[12]

The only beads from medieval Northeast Africa that have been analysed with LA-ICP-MS were found at the above-mentioned Quseir site.[13] Plant ash soda composition was identified for some glass beads dated from the late Ayyubid to Mamluk periods, when the site became Quseir al-Qadim (13th–14th century AD).[14] Semitranslucent light blue and translucent dark blue drawn beads from Quseir were made of the Islamic v-Na–Ca glass. A lack of comparative data with trace elements in the chemical composition did not allow the beads to be ascribed

8 Then-Obłuska 2013: Fig. 5, cat. 40
9 Francis 2002
10 Then-Obłuska and Dussubieux 2016
11 Shortland et al. 2006
12 Gratuze and Barrandon 1990; Henderson et al. 2004
13 Then-Obłuska and Dussubieux 2016
14 Then-Obłuska and Dussubieux 2016: Fig. 17

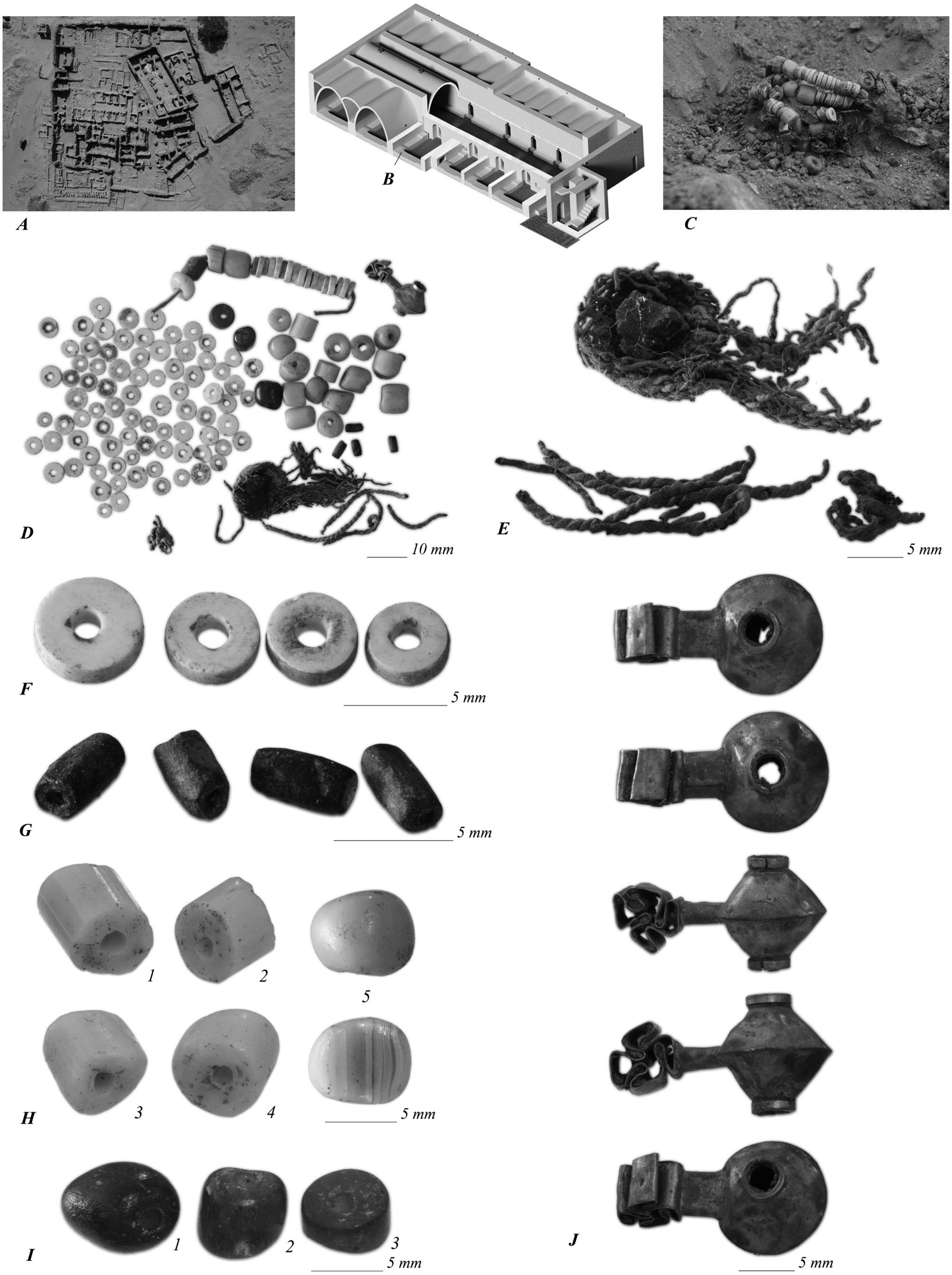

Fig. 1: (Except to otherwise stated, photos and figure design by J. Then-Obłuska) A. Monastery at Ghazali (photo by M. Bogacki) – B. Reconstruction of Ghazali dormitory (by J. Szewczyk) – C. Ghazali beads in situ (photo by A. Obłuski) – D. Ghazali beads – E. A fiber case with resin fragments – F. Ostrich eggshell beads – G. Stone beads – H. Drawn yellow beads –I. Drawn blue beads – J. Copper-alloy pendant

	Ghazali 01 blue	SD, %wt.	Ghazali 02 yellow	SD, %wt.	Ghazali 02 BIS transparent	SD, %wt.
wt%						
SiO_2	63,49	1,10	51,74	2,01	72,89	3,01
Na2O	14,23	0,21	15,02	0,42	12,24	0,29
MgO	3,41	0,02	3,35	0,08	2,39	0,02
Al_2O_3	2,30	0,05	2,42	0,12	1,67	0,04
P_2O_5	0,19	0,00	0,16	0,01	0,08	0,00
K_2O	2,98	0,06	3,16	0,09	2,36	0,07
CaO	5,10	0,15	4,54	0,21	3,13	0,03
Sb_2O_5	0,00	0,00	0,00	0,00	0,00	0,00
MnO	1,14	0,02	1,38	0,03	0,99	0,02
Fe_2O_3	1,29	0,03	0,99	0,07	0,39	0,00
CuO	0,19	0,00	0,00	0,00	0,00	0,00
SnO_2	0,49	0,00	0,90	1,56	0,23	0,09
PbO	3,04	0,07	14,14	0,31	1,82	0,01
ppm						
Li	12,8	1,0	11,6	0,8	9,2	0,8
Cl	1758	37	1940	69	1420	24
B	91,5	4,7	110	8	79,3	1,7
Sc	1,4	0,2	1,0	0,2	0,7	0,0(4)
Ti	557	24	392	9	281	4
V	13,1	0,6	10,5	0,5	7,5	0,3
Cr	33,1	2,0	18,6	3,6	13,4	2,1
Ni	127	40	5,6	9,7	6,8	1,7
Co	367	18	5,4	0,5	3,8	0,2
Zn	206	3	23,2	3,0	15,2	0,3
As	132	13	582	49	50,8	10,4
Rb	16,0	1,0	17,6	0,4	13,8	0,7
Sr	469	11	461	20,2	322	1
Zr	62,9	2,7	48,5	1,9	31,6	0,6
Ag	0,7	0,1	0,5	0,0(4)	0,5	0,1
Cs	<0,2		<0,3		<0,2	
Ba	240	11	296	10	201	7
La	4,8	0,1	4,5	0,4	3,1	0,1
Ce	9,1	0,6	8,0	0,3	6,0	0,1
Au	0,7	0,1	0,5	0,0	0,5	0,1
Y	3,8	0,4	3,3	0,4	2,4	0,2
Bi	<0,3		<0,2		<0,1	
U	0,4	0,0(4)	0,3	0,0(4)	0,3	0,1
W	1,0	0,1	0,9	0,2	0,8	0,1
Mo	1,1	0,3	1,0	0,2	1,0	0,0(4)
Nd	3,2	0,2	3,3	0,5	2,6	0,4
Hf	1,2	0,3	1,0	0,2	0,7	0,0(4)
Th	1,1	0,1	1,0	0,1	0,7	0,1

Table 1: Major, minor and trace element oxide compositions of the investigated samples.

Laser ablation characteristics and settings	
	Quantitative analysis
LA system	LSX-213
Wavelength, nm	213
Pulse duration	5 ns
Energy output, mJ	5.0
Beam diameter, µm	100
Repetition rate, Hz	20
ICP-MS characteristics and settings	
RF Power	1245
Neb. gas flow rate, $Lmin^{-1}$	0.98-0.99
Plasma gas flow rate, $Lmin^{-1}$	16.0
Carrier gas	Ar
ICP-MS data acquisition parameters	
Scanning mode	Peak hopping
Dwell time, ms	10
Pre-integration time, s	20
Integration time, s	460
Isotopes monitored	^{7}Li, ^{11}B, ^{23}Na, ^{26}Mg, ^{27}Al, ^{29}Si, ^{31}P, ^{35}Cl, ^{39}K, ^{43}Ca, ^{45}Sc, ^{49}Ti, ^{51}V, ^{53}Cr, ^{55}Mn, ^{57}Fe, ^{59}Co, ^{61}Ni, ^{65}Cu, ^{66}Zn, ^{75}As, ^{85}Rb, ^{88}Sr, ^{89}Y, ^{90}Zr, ^{95}Mo, ^{109}Ag, ^{111}Cd, ^{118}Sn, ^{121}Sb, ^{133}Cs, ^{137}Ba, ^{139}La, ^{140}Ce, ^{143}Nd, ^{178}Hf, ^{182}W, ^{197}Au, ^{202}Hg, ^{208}Pb, ^{209}Bi, ^{232}Th, ^{238}U

Table 2: Instrumental settings and data acquisition parameters

to any specific area of Islamic glass production. An Egyptian and Syro-Palestinian origin was proposed for dark blue glass, but the cobalt ore containing arsenic that was used as a colorant for some blue glasses might suggest an Iranian provenance. The concentration of arsenic in cobalt-containing beads for Quseir is higher than usual, with the Co–As ratio fairly close to 1.[15] However, the Co–As ratio of the cobalt-containing bead from Ghazali is almost 3 to 1. Therefore, a neighboring, Egyptian or Syro-Palestynian origin of the glass is proposed for the Ghazali beads, rather than an Iranian one.

Conclusions

One hundred and twenty-six beads associated with two pendants were found on a bench in one of the dormitory cells during the 2014/2015 excavation season. Yellow and blue glass, ostrich eggshell and stone beads were found together with a metal pendant and with a fiber plaited case that held a few resin pieces. The study of bead and pendant finds brings to light evidence of some links with other Christian sites in Nubia – as well as with Mediterranean cultures already recognized in other bead studies.[16] What is more, comparative study allows to date the objects to the period between the late 10th and 12th century AD. The results of chemical compositional analysis point to an Islamic origin of the glass used in Ghazali bead production. Consequently, they confirm strong connections between the material cultures of Christian Nubia and Islamic East Mediterranean.

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Appendix

Instrumentation

An Inductively Coupled Plasma Mass Spectrometer ELAN 9000 (Perkin Elmer SCIEX, Canada) equipped with the laser ablation system LSX-213 (CETAC, USA) was used. The laser ablation set up combines a stable, environmentally sealed 213 nm UV lasers (Nd-YAG, solid state) with a high sampling efficiency, variable 1 to 20 Hz pulse repetition rate and maximum energy up to 5 $mJ.puls^{-1}$ (LSX-213). All experiments were performed using Ar as the carrier gas. CETAC standard ablation cell with an effective volume of c.a. v = 60 cm^3 was used for all measurements. Instrumental settings and data acquisition parameters are given in (Table 2).

Standards: Three different types of Archeological Reference Glasses (created to mimic historic glass recipes) were investigated to evaluate the results precision and accuracy: Corning Glass B is Na-rich/Ca-bearing sili-

15 Henderson 2013: 71–72
16 Then-Obłuska 2013

cates; Corning Glass C is rich in Pb and Ba; Corning Glass D is K and Ca-rich silicate.[17] Standard glass NIST SRM 610 was used as the external standard. The results for all samples were calculated with SiO_2 as the internal standard and the normalization procedure.

For all measurements, the samples were placed inside the ablation cell with NIST SRM 610 and with the selected Corning Glass. The preferred reference values for the NIST 610 were used from GeoReM (http://georem.mpch-mainz.gwdg.de/sample_query_pref.asp), while the reference values for Corning Glass were compiled from Brill[18] and Wagner et.al.[19] The calibration material was measured twice at the beginning and twice at the end of each run to correct for eventual instrumental drift. Three replicate single point ablations at locations carefully selected on the glass surface were carried out on each sample. Transient signals were recorded and evaluated for the subsequent elemental quantification. The LA-ICP-MS signals were background corrected and integrated using Excel program. The signal for integration was individually selected considering the corrosion of the glass surface, therefore the first seconds of the transient signals were withdrawn from calculations to omit the influence of the corroded internal glass layers on the bulk information about the original glass composition.

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Zusammenfassung

In der gesamten christlichen Periode (ca. 641–1400 n. Chr.) wurden in Nubien viele Kirchen und Klöster gebaut. Eines davon wird in Ghazali, zwischen dem 3. und 4. Nilkatarakt gelegen, ausgegraben. 126 Perlen, die mit zwei Anhängern assoziiert waren, wurden in der Kampagne 2014/15 auf einer Bank in einer der Schlafzellen gefunden. Gelbe und blaue Glasperlen, außerdem Straußeneierschalenperlen und Steinperlen lagen zusammen mit einem Metallanhänger und einem aus Fasern geflochtenen Behältnis, in dem sich einige wenige Harzstückchen befanden. Parallelen zu den Perlen und dem Anhänger sind aus dem mittelalterlichen Nubien bekannt und erlauben eine Datierung in das 10.–12. Jh. n. Chr. Zwei Proben wurden mittels Laserablation mit induktiv gekoppelter Plasma-Massenspektrometrie (LA-ICP-MS) analysiert, um die Herkunft des Glases, das für die Manufaktur der Perlen aus Ghazali benutzt wurde, zu untersuchen. Die Perlen sind aus islamischen Glas, das ägyptische oder syro-palästinensische Herkunft hat, gefertigt.

17 Brill 1972, 1999

18 Ibid.

19 Wagner et.al 2012