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ГАРЧИГ

ТҮҮХ СУДЛАЛ

УГСААТАН СУДЛАЛ

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THE HISTORY

ETHNOGRAPHY

SCIENTIFIC ANALYSIS ON THE GLASS BEADS FROM THE XIONGNU BURIAL OF ZAMIIN UTUG

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Houle Jean-Luc[4] Tuvshinjargal Tumurbaatar [5]

Introduction

Many glass beads dating from 1st century BC to 1st century AD have been discovered in East Asia, excluding the central area of the Han Dynasty. At that time, a large quantity of glass had distributed also in the Korean Peninsula and Japanese Archipelago where are located at the east end of East Asia. Most of these beads are called Indo-Pacific Beads (IPB) made by drawing method, which ranged on a diameter mainly less than 6 mm [Frances, 1988; 1989]. IPB is assumed to have emerged in South India [Francis, 1990], and its production sites were discovered in various places of India. Besides, similar IPBs were distributed in large quantities throughout Southeast Asia and in the coastal areas of southern China (Lingnan region), although they differed in their primary colors.

In ancient time, several kinds of glass with different chemical compositions were produced in the Western region such as the Mediterranean and the Middle East, in the Southern region such as India to Southeast Asia, and the Eastern region such as East Asia. For example, in the Western region, people produced soda glass made from evaporated salt called natron or plant ash as a soda raw material [Sayre and Smith 1974]. They are distinguished by the content of potassium oxide (K_2O) and magnesium oxide (MgO), and those containing less than approximately 1.5% of both components are called natron glass, while those containing more are called plant-ash glass. The former is considered to originated from the Mediterranean region, while the latter is considered to originated from West Asia to Central Asia. In contrast, people produced potash glass and high-alumina type soda glass in India and Southeast Asia, while produced lead glass and lead-barium glass in East Asia.

It has been found that there is a certain correlation between the bead-making technique and chemical composition (Oga and Tamura 2013, Table 1.). Natron glass (Group SI) and plant-ash glass (Group SIII) originated in the Western region connected characteristically with techniques such as the segmenting method and the folding method. Although there are some small monochrome beads made by the drawing method, most of them differ from the typical IPBs in terms of size and other characteristics. Meanwhile, most of the glass beads of potash glass (Group PI, PII) and high-alumina type soda glass (Group SII), which are assumed to be produced from India to Southeast Asia, are typical IPBs made by drawing method.

Also, in the Mongolian plateau, various types of glass beads have been found in the Xiongnu burials [Eregzen, 2011]. However, the Xiongnu glass beads have different features from the those of glass beads from the coastal region of East Asia. Hence, in this study,

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we will examine the bead-making technique and chemical composition of the glass beads unearthed from the Xiongnu burials of Zamiin Utug (N 49° 18' 04.6; E 95° 25' 41.3) in Uvs province which had the largest number of glass beads [Bayarsaikhan et al, 2020].

2. Research Methods

Observation by stereo microscope (Nikon Fabre Photo EX) was carried out to deduce the bead-making technique from the positions and shapes of air bubbles in the glass beads and the characteristic shapes of the stringing holes. The chemical composition of the glasses was analyzed by a non-destructive method using a portable energy dispersive X-ray fluorescence analyzer (OURSTEX 100FA). XRF has commonly used for compositional analysis of ancient glass artifacts, and many articles has been published (cf. Kato et al., 2009, Abe et al., 2012). The target of the X-ray tube is palladium (Pd). The X-ray tube voltage is set to 40 kV, and the X-ray tube current is automatically adjusted to optimize the detector's dead time. The measurements are conducted in a vacuum. The measurement results were normalized by the fundamental parameter (FP) method calibrated using a standard glass sample (Corning Glass A) in a way that the total amount of the oxides of elements detected will be 100 wt.%.

Tab. 1 Compositional groups of ancient glass in Japan (Oga and Tamura 2013)

Classification of Chemical Composition		Bead-making Technique	Coloring Agent	Estimated Production Area
Lead Glass Group	Group LIA	winding	Copper	Northeast China
	Group LIB	drawing with twisting	Copper + Han Blue	South China
	Group LIC	folding	Copper	China
	Group LIIA	winding	Copper	China
	Group LIIB	winding	Copper/iron	Korea (Baekje) to Japan
Potash Glass Group	Group PI	drawing/folding/ heat penetrating	Cobalt/copper +manganese/iron	South Asia
	Group PII	drawing	Copper	North Vietnam to South China
	Group PII?	drawing	Copper + lead stannate	North Vietnam to South China?
	Group P	drawing	Manganese	Unclear
Soda Glass Group	Group SIA	folding/segmenting	Cobalt	Mediterranean
	Group SIBa	winding	Cobalt	Mediterranean
	Group SIBb	folding	Cobalt	Mediterranean
	Group SIBc	folding/segmenting	Cobalt	Mediterranean
	Group SIIA	drawing	Cobalt	South/Southeast Asia
	Group SIIB	drawing/segmenting	Copper/copper + manganese/ copper + lead stannate/lead stannate/ iron/manganese/cobalt/Cu (red)/Cu_2O (orange)	South/Southeast Asia
	Group SIIIA	folding	Iron	Central Asia/West Asia
	Group SIIIB	drawing/segmenting	Cobalt/iron	Central Asia/West Asia
	Group SIIIC	anomalous drawing	Cobalt/copper/manganese/ lead stannate/copper + lead stannate	Central Asia/West Asia
	Group SIV	drawing	Cobalt	South/Southeast Asia
	Group SVA	drawing	Copper + lead stannate/ Cu (red)	South/Southeast Asia
	Group SVB	segmenting	Copper	Unclear
	Group SVC	heat penetrating	Copper	Unclear

We confirmed the accuracy of quantification of the FP method in this study as follows. Five randomly chosen locations were measured on the standard glass EC 1.1 (a float glass available from the British Glass Industry Association). The measured values calculated in this manner and the reference values of the standard samples were then compared, and the dispersion of the measured values and the accuracy were evaluated. The results are shown in Table 2. The result shows that the accuracy is enough to determine the type of glass we are interested in, such as natron glass and plant-ash glass.

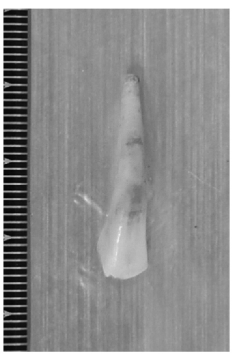
Table. 2 Known composition of EC1.1 against normalized XRF results for EC1.1.

EC1.1	Measured composition	Known composition
	Mean (wt.%, n=5) ± SD (1σ)	Reference values (wt.%) ± SD (1σ) *
Na_2O	13.47 ±0.20	13.41 ± 0.11
MgO	4.03 ±0.11	3.78 ± 0.10
Al_2O_3	0.96 ±0.20	1.08 ± 0.06
SiO_2	72.03 ±0.60	71.97 ± 0.14
K_2O	0.61 ± 0.05	0.59 ± 0.05
CaO	8.47 ± 0.55	8.63 ±0.09
TiO_2	<0.01	0.040 ±0.002
Fe_2O_3	0.13 ± 0.02	0.103 ±0.004

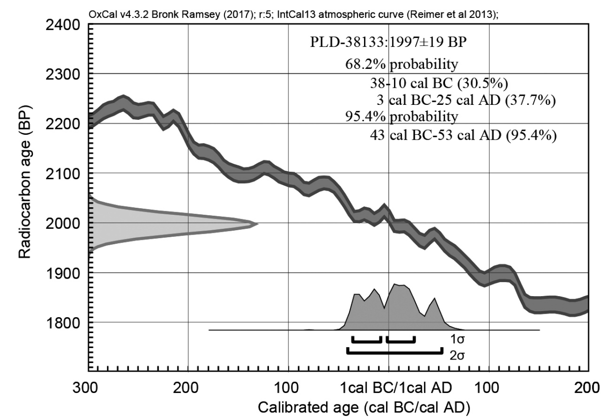
* Fletcher 1976

However, it must be noted that we conducted a completely non-destructive method to analyze the weathered surface of the glass beads. Therefore, the results of analysis do not directly indicate the chemical composition of the glass in its original or non-weathered state, but nevertheless, they are thought to provide certain hints to identify the compositional types and colorants of the glasses.

3. Analysis results of beads from Zamiin Utug



Sample No. 32-5



Measurement number	δ13C (‰)	Expected 14C age BP	Calibrated age BC (1 σ)	Calibrated age BC (2 σ)
PLD-38133 sample No.32-5	-19.46±0.19	1997±19	38-10 cal BC (30.5%) 3 cal BC-25 cal AD (37.7%)	43 cal BC-53 cal AD (95.4%)

*Mesured by Paleo Labo CO.,ltd

Fig. 1 Sheep tooth from Zamiin Utug burial No. 3-1 and its 14C dating

Around 1000 beads were discovered from burial No. 3-1 which is a circler burial of Xiongnu. This burial is one of several relatively small burial that surrounds a central larger burial, but in no other case has such many glass beads been collectively found from a single grave among any known graves of Xiongnu. A sheep was also buried in the tomb, and its tooth was dated (Fig. 1). The result is 43 cal BC-53 cal AD (95.4%), which is the same age as many Xiongnu burials on the Mongolian plateau.

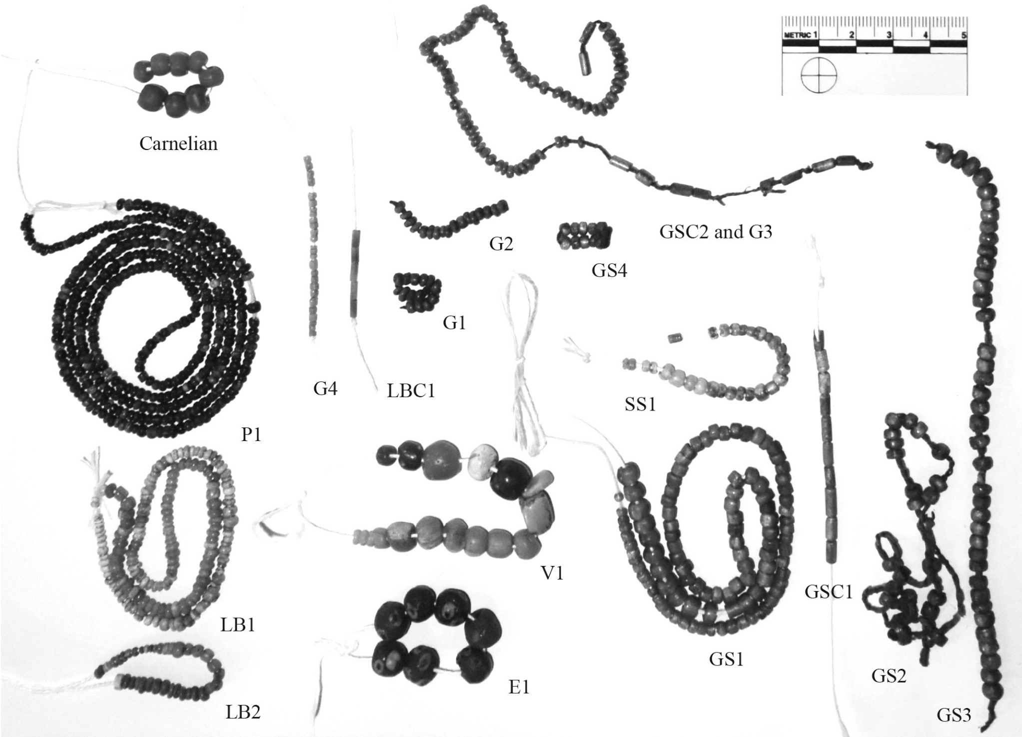
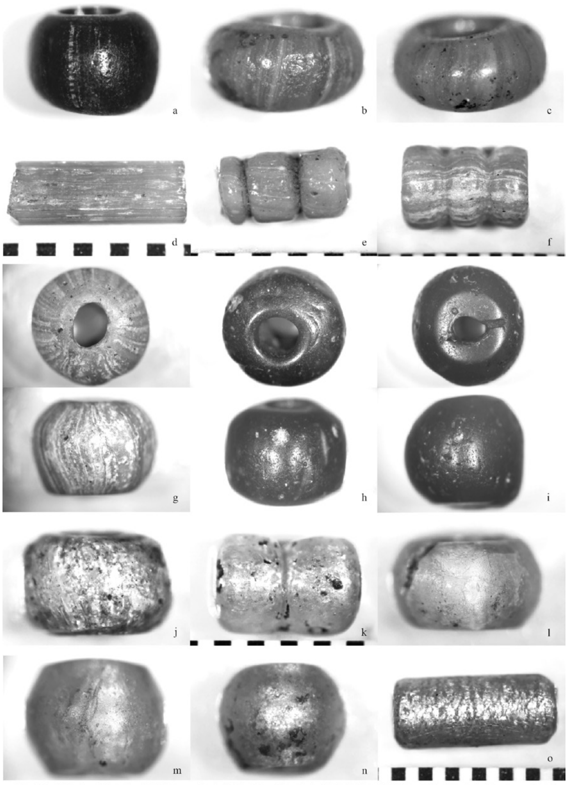


Fig. 2 Beads from Zamiin Utug burial No. 3-1

The unearthed beads consisted of various types, including monochrome glass beads, sandwich beads and eye beads (Fig. 2, 3). Some were found in their original condition strung on a thread of twisted animal hair, which provide a valuable reference for finding out how the beads had been used. Among the beads are also a small number of beads made not of glass but stone, such as carnelian and turquoise. In this study, we conducted a chemical analysis of about 115 representative glass beads that have been selected upon a careful observation of all samples. The characteristics of each type of glass beads are described below. The compositional characteristics of potash glass and soda are shown in Fig. 4 and 5; their concentration of heavy elements is shown in Fig. 6.

IPB They are transparent deep purple, translucent light blue, and translucent yellow-green in color (Fig. 2: P1, LB1, LB2; Fig. 3a-c). Among these, the deep purple transparent beads (beads of P1) are quite similar in appearance to those from Khцkh Ьzььriin Dugui II in Khovd province at the eastern foot of the Altai Mountains (Nakamura et al 2021). As a result of XRF analysis, they are potash glass colored by manganese, but the Al_2O_3 content is lower than potash glass found in the Japanese archipelago (Fig. 4). Moreover, the amount of Rb_2O was clearly lower than beads found in the Japanese archipelago.



a: P1-3, b: LB2-6, c: LB1-19, d: LBC-1, e: G4-7, f: V1-15, g: V1-12, h: V1-2, i: V1-3, j: SS1-14, k: SS1-2, l: SS1-3, m: GS1-9, n: GS1-101, o: GSC1-1

Fig. 3 Magnified photos of glass beads from Zamiin Utug burial No. 3-1

The transparent light blue and translucent yellow-green beads are made of soda glass (beads of LB1, LB2). The former contains 0.2% to 1% CuO, and this indicates that they are colored by copper ion. It is particularly worth noting that they also contain 0.2% to 0.9% Sb_2O_5 (Fig. 6a). The latter contains a yellow pigment as a colorant, which can be observed as a yellow line that runs parallel to the hole. As it contains high amounts of SnO_2 and PbO (Fig. 6b), it might be lead-stannate (ex. $PbSnO_3$), but as it also contains high Sb_2O_5, the possibility of lead-antimonite (ex. $Pb_2Sb_2O_7$) cannot be dismissed. Having a Cu_2O content of more than 1%, the copper ion (Cu^{2+}: light blue) and yellow pigment give the beads a translucent yellow-green appearance. Zinc (Zn) has also been detected, but it is thought to be an impurity in the copper raw material. IPBs colored with copper raw materials containing Zn are rarely found in coastal areas of East Asia.

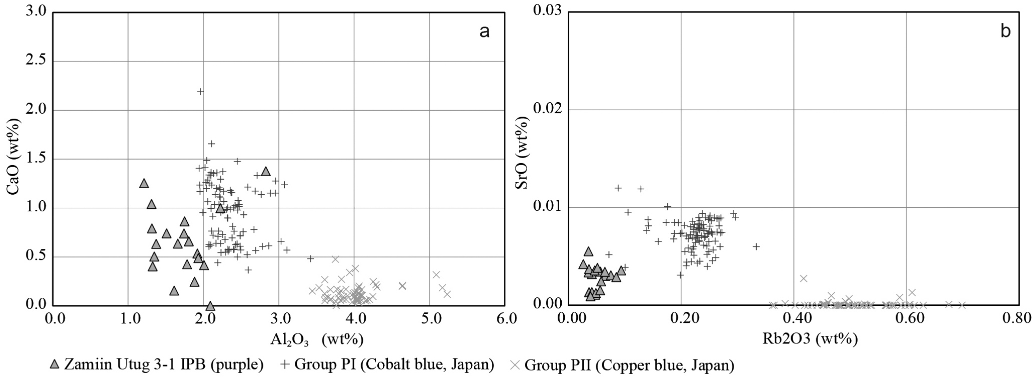


Fig. 4 Characterization of potash glass (a: CaO vs Al_2O_3, b: SrO vs Rb_2O)

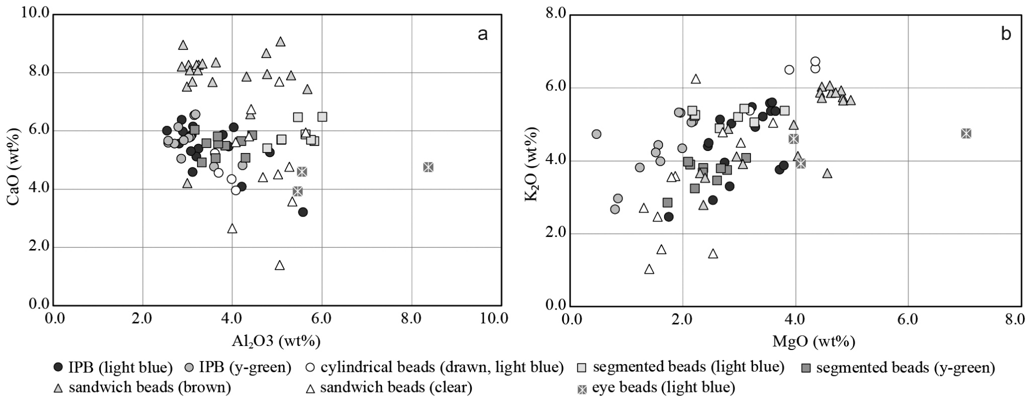


Fig. 5 Characterization of soda glass of Zamiin Utug (a: CaO vs Al_2O_3, b: K_2O vs MgO)

These soda glass IPBs contain a larger amount of MgO and K_2O content (Fig. 5b) and may correspond to the plant-ash glass or the proto-high-alumina soda glass (Group SV). It should be noted, however, that the translucent yellow green IPBs tend to contain smaller amounts of MgO compared to the transparent light blue IPBs. In any case, in the Japanese Archipelago and other coastal area of East Asia and Southeast Asia, IPBs containing antimony were not common, so these beads may not belong to any of the existing compositional groups shown in Table 1.

Regarding the beads related to IPBs, light blue transparent cylindrical glass beads made by drawing method (Fig. 2: LBC; Fig. 3d) were unearthed. The characteristics of their chemical compositions are mostly the same as those of the light blue and yellow green IPBs (LB1, most of LB2) mentioned above. However, these light blue transparent glass tubes do not contain antimony. Therefore, antimony in light blue and yellow green IPBs may be derived from pigments as opacifiers or colorants.

Monochrome soda glass beads other than IPB Monochrome glass beads made by the segmenting method and folding method have also been unearthed. We will discuss below the glass beads made by the segmenting method which were unearthed in large numbers.

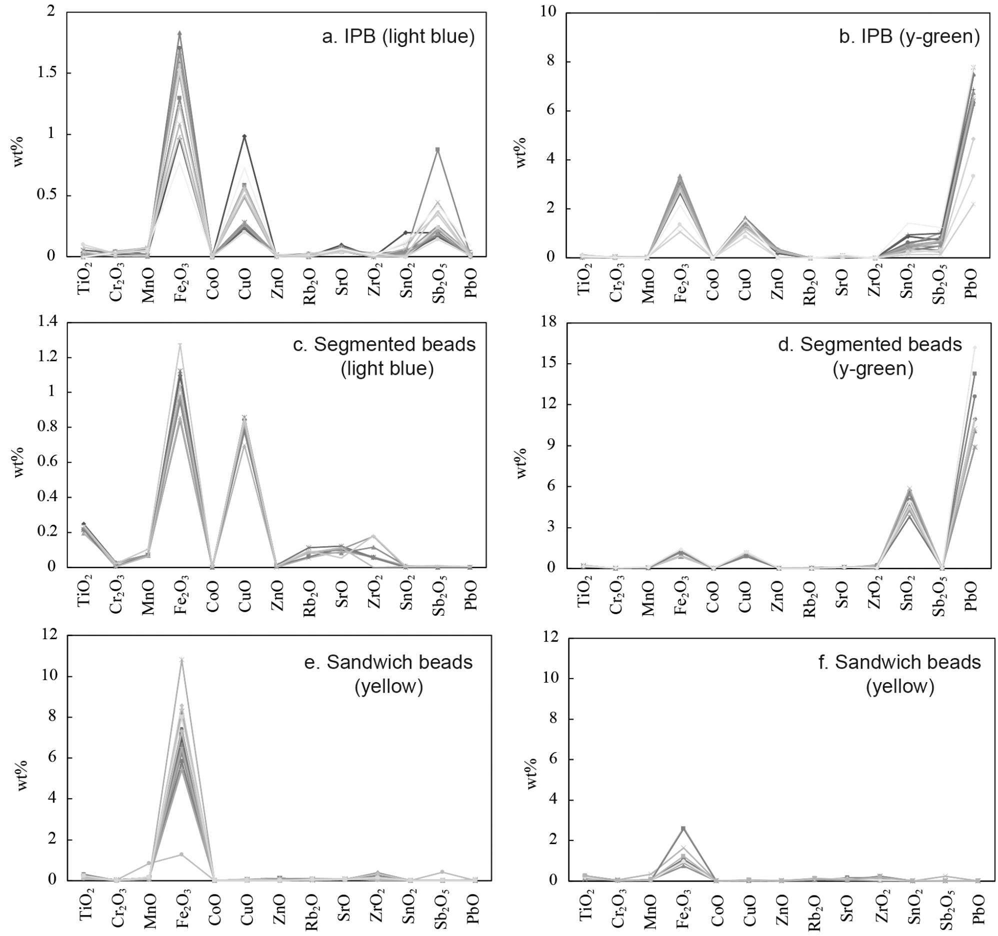


Fig. 6 Characterization of heavy elements of soda glass of Zamiin Utug

The glass beads made by the segmenting method are either opaque yellow green (Fig. 2: G4; Fig. 3e) or translucent or opaque light blue (Fig. 2: some of LB2, some of V1). The former are minute beads with a diameter of more or less 1.5mm and include single to triple-segmented beads. Stripes of yellow opaque particles run extending spirally parallel to the hole. The yellow green color comes from copper ion and the lead-stannate of an artificial yellow pigment (Fig. 6d). The translucent and opaque light blue beads (Fig. 3f-g) are colored by copper, but some contain SnO_2 and Sb_2O_5 and some do not (Fig. 6c).

As compositional characteristics, these segmented beads contain a large amount of MgO and K_2O (Fig. 5b), which suggests the possibility that the beads correspond to the plant-ash glass or the proto-high-aluminum type of soda glass. The chemical composition is similar to the above-mentioned soda glass IPBs, but the segmented light blue beads tend to have a slightly higher Al_2O_3 content. No glass beads with such a chemical composition have been found in the Japanese Archipelago so far, so these beads probably do not correspond to any of the existing compositional groups.

Sandwich beads Sandwich beads are made of either transparent yellow glass (Fig. 2: GS1, etc.; Fig. 3m-o) or close to colorless transparent glass (Fig. 2: SS1; Fig. 3j-l), with the former accounting for the majority. As they contain a significantly different amount of Fe_2O_3 (Fig. 6e-f), a larger amount of iron may have been intentionally added to the transparent yellow beads. The metal foil material is mostly silver (Ag), but gold (Au) was also detected in one yellow sandwich bead and one colorless sandwich bead among the 31 samples that were analyzed. These two were found to contain small amounts of manganese (MnO) and antimony (Sb_2O_5), which may have been added as decolorants.

All the sandwich beads were judged to be made of soda glass. Particularly, the yellow sandwich beads have high MgO and K_2O content and are likely to be equivalent to plant-ash glass. However, it differs from the typical plant-ash glass produced in West Asia due to a pronounced trend of $MgO<K_2O$ and a slightly higher content of Al_2O_3.

On the other hand, the colorless sandwich beads tend to contain less MgO and CaO as well as higher amounts of Al_2O_3 than those with transparent yellow sandwich beads (Fig. 15a-b). We consider these colorless sandwich beads are likely to be a plant-ash glass so far, but it is noteworthy that a relatively large number of samples with low CaO appeared. The effects of weathering are also undeniable, but could be a different compositional group from yellow sandwich glass beads.

Eye beads Eye beads of characteristic design have been unearthed from this burial (Fig. 2: E1). They have an opaque light blue base bead made by the folding method, to which black, red, and yellow mosaic glasses are attached concentrically from the center. There is high possibility that the compositional type of these glass corresponds to the plant-ash glass. Although it tends to contain more K_2O than MgO, but its rather small a CaO content and large Al_2O_3 content (Fig. 5a-b) indicates that it differs from the plant-ash glass that is common in West Asia. The opaque light blue base bead is colored by copper, the red mosaic part is probably by a colloidal particle of elemental copper, and the yellow mosaic part is by lead-stannate. Regarding the central black part, it requires further study.

3. Discussion

The analysis result of Zamiin Utug gives us some insights into the trade routes of glass beads. Regarding IPBs, the compositional characteristics differed from those distributed in the Japanese Archipelago and the Korean Peninsula. In particular, the light blue and yellow green IPBs of soda glass (Fig. 2: LB1, most of LB2, G4) contained antimony (Sb). Antimony coloring (or decoloring) techniques are frequently used in plant-ash and natron glass produced in West Asia and the Mediterranean world but are not common in IPBs of Indian or Southeast Asian origin. In other words, from the viewpoint of bead-making techniques, it is estimated to have been produced in South Asia region including India, but also in regions closer to West Asia and the Mediterranean. In addition, IPBs excavated from the Xiongnu burials in Mongolia, which often contain purple potash glass like Zamiin Utug and Khцkh Ьzььriin Dugui II, are not a common type in coastal Southeast Asia and the East Asian region. This indicates that it may have been produced inland, away from the maritime trade routes of the time.

As for the sandwich glass beads, the *gold* and *silver* glass beads are mostly plant-ash glass. The details will be discussed in another article, but the case of Zamiin Utug is significantly different because the sandwich glass from the other Xiongnu burials is almost all natron glass [Tamura et al. 2019].

Other than glass beads from Zamiin Utug, most of the glass beads and vessels from the Xiongnu burials are natron glass, such as cobalt blue beads from Gol Mod II burial No. 30, cobalt blue vessels and purple vessels from Gol Mod II burial No. 1 (Nakamura et al 2021). Besides, the plant-ash glass of Zamiin Utug has slightly different compositional characteristics compared to typical plant-ash glass produced in the West Asia. These beads show $MgO<K_2O$, and it indicates to be produced in Central Asia.

Incidentally, an interesting case related to this is the Bara site near Peshawar, Pakistan [Honeychurch, 2015:283]. Many unfinished glass beads containing sandwich beads have been excavated from this site, which is considered a production site of glass beads. All of the glass beads found from the Bara site are of plant-ash glass, and they are distinguished by their high Al_2O_3 content compared to the common plant-ash glass in West Asia, suggesting that they were produced in the Indo-Pakistan region [Dussubieux and Gratuze, 2003]. In short, the plant-ash glass from the Xiongnu burial of Zamiin Utug could have been produced in closer areas to South Asia even among Central Asia. In addition, the plant-ash eye beads of Zamiin Utug are also similar to the above-mentioned Bara and at the Khotan Bizili cemetery in Xinjiang in China.

4. Conclusion

Previous studies have analyzed four glass beads in the Duurlig Nars site [Yung et al. 2014] and found that soda glass had been brought to the Xiongnu. Our analysis was able to show new variety and the source origin of the Xiongnu beads. Based on the above, glass beads from Xiongnu burials of Zamiin Utug are considered to have come from the northern part of South Asia or the southern part of Central Asia like Indo-Pakistan region.

Besides, it was also found that glass beads made in the Han dynasty was extremely rare, even though the Xiongnu received many bronze mirrors and harness ornaments from the Han dynasty. In other words, the glass beads of the Xiongnu were the products of trade with the West. Furthermore, the fact that only plant-ash glass was buried in large quantities in Zamiin Utug suggest that the elite of each area in Xiongnu territory may have had a distinctive trading network. Otherwise, it is also possible that Zamiin Utug burial No. 3-1 had a different character from the other elite burials, namely that it had a different status and role. We would like to continue to examine this point while waiting for more cases to be excavated.

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ТОВЧЛОЛ

Замын өтөгийн Хүннү булшнаас гарсан шилэн сувсанд хийсэн X-Ray шинжилгээ

Хүннү булшнаас Ромын шилэн аяганаас гадна мөн олон төрлийн шилэн сувснууд гардаг билээ. Эдгээрээс хамгийн олон тоотой шилэн сувснуудыг Увс аймгийн Зүүнхангай сумын нутаг Замын өтөгийн 3-1 тоот булшнаас 2017 онд Монгол-Америкийн хамтарсан "Баруун Монгол" төслийн багийн судлаачид илрүүлэн судалжээ. Энэ булшнаас гарсан хонины гавлын ясны дээж НТӨ 43 -НТ 53 он (95.4%), хүний шүдний дээж НТӨ 112-НТ 52 онд (94.4%) тус тус холбогдох радиокарбоны шинжилгээний үр дүн гарсан нь Монголын өндөрлөг дэх Хүннүгийн бусад оршуулгын газрын ерөнхий он цагтай ижил болохыг харуулж байна. Замын өтөгөөс гарсан шилэн сувс нь нэг цул, давхар үелсэн, алаглууж өөр өнгийн нүд гаргасан зэрэг олон төрөл байна. Эдгээр шилэн сувсны гарал үүслийг тодорхойлохын тулд бид зөөврийн X-Ray (OURSTEX 100FA) ашиглан рентген гэрэлт цацрагийн шинжилгээ хийв.

Шинжилгээний үр дүнгээс харахад ихэнх шилэн сувснууд нь Энэтхэг-Номхон далайн (IPB) бүс нутгийн шилэн сувсны шинж төрхийг агуулж байв. Үүнээс гадна содын шил, ургамлын үнсний шилээр хийсэн сувснууд байв. Замын өтөгийн Энэтхэг-Номхон далайн бүс нутгийн гаралтай шилэн сувснууд найрлага, шинж чанарын хувьд Японы арал болон Солонгосын хойгт ижил цаг хугацаанд тархаж байсан сувснуудаас онцлог ялгаатай байлаа. Тухайлбал, зарим шилэн сувснууд нь сурьмагийн (antimony) маш өндөр агууламжтай байгаа нь тэдгээрийг өмнөд Азийн эрэг орчимд үйлдвэрлээгүй болохыг нотолж байна. Замын өтөгийн давхар үелсэн болон алт, мөнгөлөг өнгөтэй шилэн сувснуудыг ургамлын үнсний шилээр хийжээ. Энэ нь Хүннү булшнаас ихэнхдээ гардаг натри (natron) сувснуудаас эрс ялгаатай. Замын өтөгийн бусад ургамлын үнсний шилээр хийсэн сувснуудад магнийн оксидоос /MgO/ нь Калийн исэл /K_2O/ их байгаа нь Баруун Ази биш Төв Азид үйлдвэрлэгдсэн болохыг харуулж байна.

Дээрх дүн шинжилгээ болон Пакистаны Бара дурсгалт газрын жишээг харгалзан бид Замын өтөгийн шилэн сувсны ихэнхийг Өмнөд Азийн ойролцоох Төв Азийн бүс нутагт үйлдвэрлэсэн хэмээн үзэж байна. Цаашид Хүннүгийн оршуулгын газар, баялаг олдвор, эх сурвалжуудад тулгуурлан Хүннү гүрэнд бүс нутгийн худалдааны сүлжээ байсан эсэх, эсвэл Замын өтөгт оршуулсан хүн өвөрмөц тохиолдол байсан эсэх талаар гүнзгийрүүлэн авч үзэх болно.

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App. 1 Chemical Composition (MT: making technique, D: drawing, S: Segmenting, SS: Sandwich and Segmenting, F: Folding, W: widing, tp: transparent, tl: translucent, op: opaque, +: foil material, (): decolorant)

No.	MT	type	color		colornat	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	Cr_2O_3	MnO	Fe_2O_3	CoO	NiO	CuO	ZnO	Rb_2O	SrO	ZrO_2	SnO_2	Sb_2O_5	BaO	PbO
Zamiin Utug P1 (Purple IPB)																												
1	D	P	purple	tl	Mn	0.7	0.7	1.3	76.4	1.7	0.3	13.2	0.8	0.32	0.00	3.49	0.32	0.00	0.00	0.01	0.00	0.04	0.00	0.01	0.00	0.00	0.73	0.00
2	D	P	purple	tl	Mn	0.8	0.9	1.5	83.2	2.2	0.2	6.3	0.7	0.33	0.00	2.74	0.33	0.00	0.00	0.01	0.00	0.07	0.00	0.01	0.00	0.00	0.57	0.00
3	D	P	purple	tl	Mn	0.6	0.9	1.3	76.3	1.6	0.2	14.2	0.4	0.34	0.00	3.24	0.32	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.39	0.00
4	D	P	purple	tl	Mn	0.6	0.9	1.3	74.4	2.3	0.1	13.9	1.0	0.46	0.00	3.83	0.36	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.79	0.00
5	D	P	purple	tl	Mn	0.8	0.9	1.7	75.0	2.0	0.3	12.8	0.9	0.35	0.00	3.93	0.71	0.00	0.00	0.01	0.00	0.06	0.00	0.03	0.00	0.04	0.43	0.00
6	D	P	purple	tl	Mn	1.0	0.7	1.3	76.6	2.1	0.2	13.6	0.5	0.40	0.00	2.96	0.32	0.00	0.00	0.00	0.01	0.09	0.00	0.01	0.00	0.00	0.13	0.00
7	D	P	purple	tl	Mn	0.9	1.1	2.8	74.4	2.5	0.6	11.8	1.4	0.28	0.00	3.06	0.38	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.00	0.75	0.00
8	D	P	purple	tl	Mn	1.3	1.1	1.8	76.1	2.5	0.2	11.1	0.7	0.25	0.00	3.15	0.69	0.00	0.00	0.02	0.00	0.08	0.00	0.00	0.00	0.00	1.10	0.00
9	D	P	purple	tl	Mn	0.9	0.8	1.4	79.1	1.6	0.2	11.7	0.6	0.23	0.00	2.76	0.29	0.00	0.00	0.01	0.01	0.05	0.00	0.00	0.00	0.00	0.41	0.00
10	D	P	purple	tl	Mn	1.0	0.8	1.2	75.6	1.9	0.1	14.0	1.3	0.29	0.00	2.94	0.37	0.00	0.01	0.01	0.00	0.04	0.00	0.01	0.03	0.00	0.41	0.00
11	D	P	purple	tl	Mn	1.0	1.1	2.2	78.1	2.0	0.5	9.5	1.0	0.37	0.00	3.21	0.53	0.00	0.00	0.02	0.00	0.04	0.01	0.00	0.00	0.01	0.23	0.00
12	D	P	purple	tl	Mn	1.1	1.0	1.9	73.9	1.8	0.4	12.9	0.5	0.39	0.00	3.87	0.76	0.00	0.00	0.04	0.01	0.04	0.00	0.03	0.00	0.00	1.29	0.00
13	D	P	purple	tl	Mn	0.9	0.7	1.7	69.9	3.0	0.2	15.0	0.6	0.75	0.00	4.46	0.65	0.00	0.00	0.00	0.01	0.03	0.00	0.04	0.00	0.01	1.93	0.00
14	D	P	purple	tl	Mn	1.4	1.0	2.0	73.0	2.8	0.2	12.1	0.4	0.56	0.00	4.05	0.76	0.00	0.00	0.02	0.00	0.05	0.00	0.02	0.00	0.00	1.75	0.00
No.	MT	type	color		colornat	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	Cr_2O_3	MnO	Fe_2O_3	CoO	NiO	CuO	ZnO	Rb_2O	SrO	ZrO_2	SnO_2	Sb_2O_5	BaO	PbO
15	D	P	purple	tl	Mn	0.8	0.9	1.9	73.9	2.6	0.3	13.3	0.2	0.54	0.00	3.92	0.46	0.00	0.00	0.00	0.00	0.06	0.00	0.01	0.00	0.00	1.02	0.00
16	D	P	purple	tl	Mn	0.9	0.9	1.9	72.3	3.0	0.3	14.3	0.5	0.50	0.00	3.39	0.54	0.00	0.00	0.00	0.00	0.05	0.00	0.02	0.01	0.00	1.36	0.00
17	D	P	purple	tl	Mn	1.4	1.1	2.1	79.6	3.0	0.2	9.0	0.0	0.36	0.00	2.62	0.28	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.15	0.00
18	D	P	purple	tl	Mn	1.0	0.8	1.7	73.3	2.4	0.2	14.2	0.7	0.67	0.00	3.89	0.37	0.00	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.55	0.00
19	D	P	purple	tl	Mn	1.0	0.9	1.8	73.7	2.9	0.2	13.5	0.4	0.60	0.00	3.63	0.32	0.00	0.00	0.01	0.01	0.06	0.00	0.00	0.00	0.00	0.94	0.00
20	D	P	purple	tl	Mn	1.1	1.0	1.6	76.0	2.6	0.1	12.6	0.2	0.41	0.00	3.34	0.31	0.00	0.00	0.00	0.00	0.08	0.00	0.02	0.00	0.00	0.71	0.00
Zamiin Utug LB2 (toal 39 beads including 2 stone beads; 2-14, 25-27: IPB; 15-22: segmented)																												
2	D	SIII/SV	y-green	tl/op	Cu, Sn, Sb, Pb	4.2	1.6	2.8	66.7	0.0	-	4.4	6.1	0.01	0.03	0.04	3.14	0.00	0.00	1.45	0.33	0.00	0.09	0.00	0.88	0.73	tr	7.45
3	D	SIII/SV	y-green	tl/op	Cu, Sn, Sb, Pb	3.4	0.5	3.2	67.1	0.1	-	4.7	6.5	0.06	0.04	0.01	3.33	0.00	0.00	1.63	0.35	0.00	0.09	0.00	0.62	0.81	nd	7.50
5	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	3.5	1.6	3.1	67.7	0.0	-	4.0	5.8	0.04	0.04	0.01	3.20	0.00	0.00	1.42	0.31	0.00	0.09	0.00	0.55	1.02	nd	7.76
6	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	2.2	0.9	3.6	74.2	0.0	-	3.0	4.8	0.04	0.07	0.00	2.64	0.01	0.00	1.24	0.24	0.00	0.08	0.00	0.28	0.49	tr	6.41
7	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	5.3	2.0	2.6	68.1	0.0	-	4.3	5.6	0.01	0.01	0.00	2.85	0.00	0.00	1.29	0.18	0.00	0.08	0.00	0.62	0.82	tr	6.35
8	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	3.1	1.2	2.9	70.6	0.0	-	3.8	5.0	0.03	0.03	0.02	2.90	0.00	0.00	1.28	0.18	0.00	0.09	0.00	0.94	1.00	tr	6.86
9	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	1.5	0.8	4.2	73.7	0.6	-	2.7	4.8	0.03	0.01	0.04	2.79	0.00	0.00	1.21	0.26	0.00	0.08	0.00	0.48	0.48	tr	6.20
10	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	4.9	1.5	2.7	68.8	0.0	-	4.2	5.6	0.00	0.04	0.02	3.20	0.00	0.00	1.24	0.25	0.00	0.07	0.00	0.53	0.69	nd	6.22
11	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	4.6	2.2	2.6	70.1	0.0	-	5.1	5.7	0.09	0.01	0.04	2.75	0.00	0.00	1.21	0.29	0.00	0.07	0.00	0.33	0.22	nd	4.84
12	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	3.8	2.0	3.0	68.4	0.0	-	5.3	5.8	0.07	0.01	0.01	2.95	0.00	0.00	1.29	0.30	0.00	0.07	0.00	0.41	0.32	nd	6.28
13	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	4.0	1.9	3.2	65.8	0.0	-	5.3	6.6	0.12	0.02	0.03	3.33	0.01	0.00	1.49	0.34	0.00	0.08	0.00	0.46	0.63	tr	6.75
14	D	SIII/SV	y-green	op	Cu, Sn, Sb, Pb	4.5	2.2	2.9	67.4	0.0	-	5.1	5.7	0.02	0.03	0.05	2.91	0.00	0.00	1.31	0.32	0.00	0.08	0.01	0.33	0.72	tr	6.50
15	S?	SIII/SV	light blue	op	Cu	2.5	2.2	6.0	72.8	1.2	1.0	5.2	6.5	0.25	0.03	0.07	1.10	0.00	0.00	0.84	0.01	0.08	0.10	0.06	0.00	0.00	tr	0.00
16	S?	SIII/SV	light blue	op	Cu	3.4	3.0	4.8	74.7	0.9	0.5	5.2	5.4	0.20	0.02	0.07	0.84	0.00	0.00	0.79	0.01	0.08	0.08	0.12	0.01	0.00	tr	0.00
17	S?	SIII/SV	light blue	op	Cu	5.0	3.1	5.1	72.0	1.1	0.5	5.4	5.7	0.20	0.02	0.07	0.86	0.00	0.00	0.70	0.00	0.05	0.09	0.06	0.01	0.00	tr	0.00
18	S?	SIII/SV	light blue	op	Cu	3.1	2.7	5.6	73.4	1.4	0.5	4.9	5.9	0.21	0.01	0.07	1.12	0.00	0.00	0.86	0.01	0.11	0.12	0.06	0.00	0.00	tr	0.00
19	S?	SIII/SV	light blue	op	Cu	2.7	2.2	5.8	74.5	1.0	0.5	5.3	5.6	0.22	0.00	0.07	0.95	0.00	0.00	0.78	0.01	0.06	0.11	0.05	0.00	0.00	tr	0.00
20	S?	SIII/SV	light blue	op	Cu	3.5	3.3	5.1	74.0	0.2	0.6	5.0	5.7	0.23	0.03	0.07	0.98	0.00	0.00	0.82	0.01	0.08	0.10	0.18	0.00	0.00	tr	0.00
21	S?	SIII/SV	light blue	op	Cu	3.0	2.2	5.8	74.6	0.0	1.1	5.4	5.7	0.24	0.00	0.06	1.04	0.00	0.00	0.83	0.01	0.08	0.11	0.00	0.00	0.00	tr	0.00
22	S?	SIII/SV	light blue	tl	Cu	9.2	3.8	5.5	65.9	0.4	0.6	5.4	6.5	0.24	0.02	0.10	1.28	0.00	0.00	0.85	0.01	0.10	0.05	0.18	0.01	0.01	tr	0.00
25	D	SIII/SV	y-green	tl	Cu, Sn, Sb, Pb	5.9	3.3	2.7	74.5	0.0	-	3.7	5.0	0.06	0.01	0.04	1.06	0.00	0.00	1.09	0.00	0.00	0.04	0.00	0.14	0.14	tr	2.21
26	D	SIII/SV	y-green	tl	Cu, Sn, Sb, Pb	1.7	1.0	3.0	85.2	0.0	-	0.8	2.1	0.10	0.03	0.01	1.36	0.00	0.00	0.85	0.00	0.00	0.04	0.00	0.22	0.30	tr	3.33
27	D	SIII/SV	y-green	tl	Cu, Sn, Sb, Pb	3.2	0.0	3.8	67.4	5.4	-	0.7	5.0	0.06	0.01	0.00	2.16	0.00	0.00	1.55	0.00	0.00	0.13	0.00	1.43	1.24	nd	7.85
Zamiin Utug LB1 (light blue IPB, toal 168 beads)																												
4	D	SIII/SV	pale light blue	tp	Cu, Sn, Sb	7.8	3.7	3.2	70.2	2.9	0.5	3.8	5.4	0.00	0.02	0.01	0.96	0.00	0.00	0.98	0.00	0.00	0.10	0.00	0.20	0.20	tr	0.00
5	D	SV/SIII	pale light blue	tp	Cu	5.0	2.7	5.6	70.5	3.8	0.9	3.9	3.2	0.22	0.00	0.04	1.28	0.00	0.00	2.15	0.01	0.13	0.06	0.41	0.00	0.00	tr	0.00

6	D	SIII/SV	pale light blue	tp	Cu, Sb	5.9	2.4	3.8	69.5	5.4	0.3	4.4	5.9	0.00	0.03	0.02	1.83	0.00	0.00	0.24	0.01	0.02	0.05	0.02	0.05	0.18	tr	0.01
7	D	SIII/SV	pale light blue	tp	Cu, Sn, Sb	5.7	2.5	3.1	74.6	2.9	0.6	2.9	4.6	0.00	0.02	0.04	1.27	0.00	0.00	0.79	0.01	0.00	0.07	0.00	0.19	0.46	nd	0.19
8	D	SIII/SV	pale light blue	tp	Cu, Sb	8.6	2.9	3.2	69.7	2.7	0.5	5.0	5.1	0.06	0.03	0.01	1.58	0.01	0.00	0.28	0.01	0.00	0.05	0.00	0.01	0.22	nd	0.02
9	D	SIII/SV	pale light blue	tp	Cu, Sb	9.4	3.5	3.1	66.6	2.9	0.4	5.6	6.1	0.00	0.04	0.02	1.70	0.00	0.00	0.25	0.01	0.02	0.05	0.00	0.00	0.19	nd	0.02
10	D	SIII/SV	pale light blue	tp	Cu, Sb	10.8	3.6	2.5	67.0	2.2	0.4	5.4	6.0	0.04	0.01	0.05	1.49	0.00	0.00	0.23	0.02	0.01	0.04	0.03	0.03	0.17	tr	0.02
11	D	SIII/SV	pale light blue	tp	Cu, Sb	9.2	3.6	2.9	67.1	2.5	0.5	5.4	6.4	0.00	0.04	0.01	1.68	0.00	0.00	0.28	0.01	0.01	0.05	0.03	0.04	0.25	nd	0.02
12	D	SIII/SV	pale light blue	tp	Cu, Sb	6.5	2.7	4.0	69.3	3.7	0.2	5.1	6.1	0.00	0.03	0.06	1.50	0.00	0.00	0.49	0.00	0.01	0.05	0.03	0.00	0.21	tr	0.05
13	D	SIII/SV	pale light blue	tp	Cu, Sb	10.0	3.6	3.1	66.5	2.7	0.3	5.6	5.9	0.00	0.05	0.04	1.57	0.00	0.00	0.27	0.00	0.01	0.05	0.02	0.00	0.24	nd	0.01
14	D	SIII/SV	pale light blue	tp	Cu, Sb	5.6	2.8	4.8	70.9	3.8	0.4	3.3	5.3	0.02	0.04	0.07	1.30	0.00	0.00	0.59	0.00	0.00	0.08	0.02	0.03	0.87	nd	0.01
15	D	SIII/SV	pale light blue	tp	Cu, Sb	9.2	3.4	3.0	68.1	2.8	0.3	5.2	5.8	0.02	0.01	0.01	1.67	0.00	0.00	0.27	0.01	0.00	0.04	0.01	0.03	0.19	tr	0.01
16	D	SIII/SV	pale light blue	tp	Cu, Sb	6.2	2.5	3.9	72.1	2.4	0.6	4.5	5.5	0.00	0.04	0.07	1.08	0.00	0.00	0.57	0.00	0.02	0.06	0.00	0.07	0.45	nd	0.02
17	D	SIII/SV	pale light blue	tp	Cu, Sn, Sb	3.0	1.8	4.2	77.5	4.3	0.3	2.5	4.1	0.04	0.01	0.01	1.23	0.00	0.00	0.55	0.00	0.03	0.05	0.02	0.11	0.35	tr	0.00
18	D	SIII/SV	pale light blue	tp	Cu, Sb	5.9	3.2	2.9	73.5	0.4	0.4	5.5	6.0	0.10	0.03	0.05	1.52	0.00	0.00	0.20	0.02	0.01	0.03	0.03	0.00	0.14	tr	0.01
19	D	SIII/SV	pale light blue	tp	Cu, Sn, Sb	6.5	3.8	2.8	74.4	0.2	0.6	3.9	5.6	0.00	0.03	0.07	0.77	0.00	0.00	0.73	0.00	0.00	0.07	0.01	0.12	0.42	tr	0.09
20	D	SIII/SV	pale light blue	tp	Cu, Sb	6.9	3.3	3.1	73.0	0.9	0.5	4.9	5.3	0.08	0.03	0.08	0.99	0.00	0.00	0.51	0.01	0.00	0.05	0.00	0.01	0.38	nd	0.01
No.	MT	type	color		colornat	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	Cr_2O_3	MnO	Fe_2O_3	CoO	NiO	CuO	ZnO	Rb_2O	SrO	ZrO_2	SnO_2	Sb_2O_5	BaO	PbO
Zamiin Utug SS1 (silver/gold sandwich beads, total 26 beads)																												
1	SS	SIII	clear (ss)	tp		8.6	3.6	4.4	69.2	0.0	0.8	5.0	6.7	0.17	0.02	0.06	1.09	0.00	0.00	0.01	0.00	0.10	0.07	0.06	0.00	0.00	tr	0.00
2	SS	SIII	clear (ss)	tp		3.0	1.9	4.1	78.9	0.9	0.8	3.6	5.6	0.14	0.03	0.06	0.75	0.00	0.00	0.01	0.00	0.06	0.04	0.04	0.00	0.00	nd	0.00
3	SS	SIII?	clear (gs?)	tp	(Mn, Sb)	3.4	2.5	4.0	80.5	2.4	0.4	1.5	2.7	0.09	0.05	0.35	1.65	0.00	0.00	0.02	0.02	0.12	0.08	0.00	0.00	0.24	nd	0.00
4	SS	SIII	clear (gs?)	tp		6.4	3.0	4.4	73.5	0.1	0.5	4.5	5.8	0.18	0.03	0.07	1.00	0.00	0.00	0.02	0.01	0.11	0.06	0.23	0.00	0.00	tr	0.00
5	SS	SIII	clear (ss)	tp		3.7	2.2	5.6	71.8	0.0	2.6	6.3	5.9	0.25	0.02	0.04	1.05	0.00	0.00	0.01	0.00	0.11	0.06	0.20	0.00	0.00	nd	0.00
6	SS	SIII	clear (ss)	tp		2.2	1.8	5.3	76.8	3.5	0.6	3.6	4.8	0.19	0.03	0.05	0.90	0.00	0.00	0.02	0.00	0.08	0.09	0.04	0.00	0.00	tr	0.00
7	SS	SIII	clear (ss)	tp		2.1	1.6	5.3	80.5	1.8	1.1	2.5	3.6	0.21	0.02	0.05	0.95	0.00	0.00	0.03	0.00	0.08	0.10	0.12	0.01	0.00	tr	0.00
8	SS	SIII?	clear (ss)	tp		1.1	1.6	4.7	75.2	5.3	2.8	1.6	4.4	0.26	0.02	0.05	2.65	0.00	0.00	0.04	0.02	0.05	0.15	0.12	0.00	0.00	nd	0.00
9	SS	SIII?	clear (ss)	tp		2.2	1.4	5.1	80.5	3.0	2.2	1.0	1.4	0.27	0.03	0.03	2.58	0.00	0.00	0.02	0.01	0.02	0.17	0.15	0.00	0.00	tr	0.00
12	SS	SIII	clear (ss)	tp		1.9	1.3	5.0	79.4	0.0	3.6	2.7	4.5	0.18	0.03	0.06	0.96	0.00	0.00	0.03	0.00	0.11	0.10	0.06	0.04	0.00	nd	0.00
13	SS	SIII	clear (ss)	tp		6.4	2.7	5.0	70.0	0.0	1.3	4.8	7.7	0.27	0.01	0.08	1.22	0.00	0.00	0.05	0.02	0.13	0.05	0.20	0.00	0.00	nd	0.00
Zamiin Utug LBC (tubular drawn light blue beads)																												
1	D	SIII/SV	light blue	tp	Cu	8.2	3.2	4.1	70.4	0.9	0.2	5.4	4.0	0.22	0.01	0.06	1.33	0.00	0.00	1.93	0.02	0.04	0.03	0.05	0.00	0.00	nd	0.01
2	D	SIII/SV	light blue	tp	Cu	10.4	3.9	4.0	65.9	0.0	0.4	6.5	4.3	0.23	0.04	0.07	1.65	0.00	0.00	2.31	0.02	0.07	0.04	0.12	0.00	0.01	tr	0.02
3	D	SIII/SV	light blue	tp	Cu	16.0	8.5	0.0	49.6	0.0	0.6	11.0	5.4	0.31	0.04	0.12	2.90	0.06	0.00	4.59	0.10	0.09	0.07	0.57	0.00	0.01	tr	0.03
4	D	SIII/SV	light blue	tp	Cu	9.1	4.4	3.7	67.0	0.0	0.3	6.5	4.6	0.22	0.02	0.07	1.62	0.00	0.00	2.20	0.03	0.08	0.04	0.14	0.00	0.00	nd	0.00
5	D	SIII/SV	light blue	tp	Cu	9.7	4.4	3.6	65.3	0.0	0.4	6.7	5.2	0.24	0.03	0.08	1.63	0.00	0.00	2.29	0.02	0.06	0.05	0.29	0.00	0.00	tr	0.01
Zamiin Utug G4 (yellowish-green segmented beads, total 17 beads)																												
1	S	SIII/SV	y-green	op	Cu, Sn, Pb	8.3	2.6	3.4	57.6	0.0	-	3.5	5.6	0.13	0.02	0.05	0.92	0.00	0.00	1.10	0.00	0.03	0.09	0.05	5.73	0.00	tr	10.94
2	S	SIII/SV	y-green	op	Cu, Sn, Pb	7.3	2.8	3.8	58.8	0.0	-	3.7	5.5	0.17	0.01	0.05	0.89	0.00	0.00	1.11	0.00	0.03	0.10	0.11	5.47	0.01	tr	10.08
3	S	SIII/SV	y-green	op	Cu, Sn, Pb	7.9	2.7	3.7	57.8	0.0	-	3.8	5.6	0.20	0.00	0.05	0.91	0.00	0.00	1.14	0.00	0.00	0.08	0.07	5.88	0.00	tr	10.27
4	S	SIII/SV	y-green	op	Cu, Sn, Pb	5.3	2.1	4.3	64.3	0.0	-	3.9	5.1	0.22	0.00	0.05	0.88	0.00	0.00	1.03	0.00	0.02	0.09	0.07	3.81	0.00	tr	8.90
5	S	SIII/SV	y-green	op	Cu, Sn, Pb	3.6	2.2	3.6	61.9	0.0	-	3.2	5.1	0.14	0.02	0.06	1.28	0.00	0.00	1.11	0.00	0.00	0.06	0.25	4.73	0.00	nd	12.61
6	S	SIII/SV	y-green	op	Cu, Sn, Pb	6.2	2.4	4.2	62.2	0.0	-	3.8	5.6	0.21	0.01	0.02	0.91	0.00	0.00	1.06	0.00	0.00	0.08	0.14	4.25	0.01	tr	8.91
7	S	SIII/SV	y-green	op	Cu, Sn, Pb	5.3	2.1	4.4	59.5	0.0	-	4.0	5.8	0.26	0.01	0.06	1.18	0.00	0.00	1.14	0.00	0.01	0.10	0.20	4.85	0.00	tr	11.05
8	S	SIII/SV	y-green	op	Cu, Sn, Pb	8.8	3.1	3.7	56.7	0.0	-	4.1	5.8	0.17	0.01	0.06	0.90	0.00	0.00	1.14	0.00	0.02	0.08	0.03	4.49	0.00	tr	10.91
9	S	SIII/SV	y-green	op	Cu, Sn, Pb	3.3	1.7	3.3	62.2	0.0	-	2.8	4.9	0.14	0.01	0.04	1.19	0.00	0.00	0.89	0.00	0.00	0.08	0.04	5.01	0.00	tr	14.26
10	S	SIII/SV	y-green	op	Cu, Sn, Pb	3.2	2.4	3.2	57.4	0.0	-	3.7	6.0	0.17	0.03	0.07	1.43	0.00	0.00	1.24	0.00	0.00	0.10	0.06	4.90	0.00	tr	16.17
Zamiin Utug V1 (various kinds of beads, total 15 beads including 4 stone ones)																												
1	S	SIII/SV	blue	tl	Cu	5.2	3.9	4.9	69.7	0.0	1.0	4.6	6.1	0.26	0.01	0.10	1.31	0.01	0.00	2.66	0.01	0.04	0.07	0.20	0.00	0.00	nd	0.00
2	S	SIII/SV	blue	tl	Cu	2.3	3.5	4.7	73.8	0.0	2.0	4.4	4.7	0.34	0.01	0.15	1.32	0.00	0.00	2.43	0.01	0.07	0.06	0.30	0.00	0.00	tr	0.00
3	F	SV/SIII?	light blue	tl	Cu	1.2	1.1	1.1	85.4	1.9	0.2	4.4	2.0	0.11	0.01	0.02	0.68	0.00	0.00	1.58	0.00	0.10	0.00	0.09	0.02	0.00	nd	0.00
8	S	SIII/SV	light blue	op	Cu,Sn, Sb	2.3	3.1	2.2	78.3	1.0	0.5	5.1	5.6	0.08	0.04	0.04	1.06	0.00	0.00	0.43	0.00	0.02	0.04	0.00	0.10	0.17	nd	0.00
9	D?	SIII/SV	light blue	op	Cu,Sn, Sb	5.0	4.6	2.0	75.7	0.1	0.7	3.3	5.3	0.02	0.03	0.08	0.63	0.00	0.00	0.87	0.00	0.00	0.07	0.02	0.22	1.17	tr	0.00
10	S	SIII/SV	light blue	op	Cu,Sn, Sb	5.2	3.4	2.2	77.0	0.6	0.6	3.3	5.4	0.03	0.02	0.04	0.63	0.00	0.00	0.61	0.00	0.00	0.06	0.01	0.07	0.75	tr	0.01

11	S	SIII/SV	light blue	op	Cu,Sn, Sb	2.4	2.5	2.4	79.4	3.1	0.5	3.4	4.2	0.11	0.03	0.03	0.95	0.00	0.00	0.67	0.00	0.00	0.06	0.01	0.08	0.24	nd	0.00
12	S	SV/SIII?	light blue	op	Cu,Sn, Sb	1.6	1.4	2.6	84.1	3.4	0.6	1.8	2.7	0.04	0.02	0.02	0.86	0.00	0.00	0.29	0.00	0.00	0.06	0.00	0.11	0.43	tr	0.00
13	D?	SIII/SV	light blue	op	Cu,Sn, Sb	5.8	3.3	2.2	73.5	0.7	0.5	4.4	6.2	0.04	0.03	0.07	0.97	0.00	0.00	1.03	0.00	0.00	0.04	0.00	0.27	0.84	tr	0.07
14	S?	SIII/SV	light blue	op	Cu	2.3	4.5	5.9	71.6	0.0	0.6	5.8	6.2	0.37	0.03	0.07	1.43	0.00	0.00	0.85	0.00	0.11	0.09	0.25	0.00	0.00	nd	0.00
15	S	SIII/SV	light blue	op	Cu, Sb	2.4	2.2	1.3	82.1	0.0	0.6	3.1	5.3	0.08	0.03	0.06	1.39	0.00	0.00	0.55	0.01	0.00	0.08	0.00	0.00	0.56	nd	0.05
Zamiin Utug GS1 (silver/gold sandwich beads, total 101 beads)																												
1	SS	SIII	yellow (ss)	tp	Fe	11.0	4.6	3.0	59.2	0.1	0.2	5.9	8.3	0.18	0.04	0.13	6.77	0.00	0.00	0.02	0.11	0.08	0.06	0.36	0.00	0.00	tr	0.00
2	SS	SIII	yellow (ss)	tp	Fe	12.0	4.8	3.2	57.5	0.1	0.3	5.8	8.3	0.20	0.03	0.14	7.09	0.00	0.00	0.05	0.11	0.08	0.06	0.23	0.00	0.00	tr	0.00
3	SS	SIII	yellow (ss)	tp	Fe	10.0	4.5	3.1	60.4	0.1	0.2	6.0	8.1	0.20	0.03	0.14	6.84	0.02	0.00	0.03	0.11	0.07	0.07	0.10	0.00	0.00	tr	0.00
4	SS	SIII	yellow (ss)	tp	Fe	11.0	4.8	3.2	59.0	0.1	0.2	5.9	8.3	0.18	0.03	0.13	6.67	0.00	0.00	0.05	0.11	0.04	0.06	0.19	0.00	0.00	tr	0.00
5	SS	SIII	yellow (ss)	tp	Fe	10.9	4.4	2.9	57.5	0.3	0.9	5.9	9.0	0.21	0.02	0.16	7.41	0.01	0.00	0.06	0.12	0.07	0.06	0.18	0.00	0.00	tr	0.00
6	SS	SIII	yellow (ss)	tp	Fe	11.5	4.6	3.2	58.5	0.2	0.3	5.9	8.1	0.19	0.03	0.13	6.86	0.00	0.00	0.05	0.11	0.08	0.06	0.23	0.00	0.00	nd	0.00
No.	MT	type	color		colornat	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	Cr_2O_3	MnO	Fe_2O_3	CoO	NiO	CuO	ZnO	Rb_2O	SrO	ZrO_2	SnO_2	Sb_2O_5	BaO	PbO
7	SS	SIII	yellow (ss)	tp	Fe	11.3	4.7	2.9	59.2	0.1	0.3	5.9	8.2	0.20	0.02	0.13	6.72	0.01	0.00	0.03	0.11	0.05	0.06	0.13	0.02	0.00	tr	0.00
8	SS	SIII	yellow (ss)	tp	Fe	10.6	4.8	3.6	60.9	0.1	0.3	5.7	7.7	0.19	0.03	0.12	5.66	0.01	0.00	0.04	0.09	0.10	0.06	0.13	0.00	0.00	tr	0.00
9	SS	SIII	yellow (ss)	tp	Fe	9.1	4.6	3.6	59.8	0.0	0.4	6.1	8.4	0.21	0.00	0.14	7.17	0.00	0.00	0.02	0.12	0.07	0.07	0.22	0.00	0.00	tr	0.00
10	SS	SIII	yellow (ss)	tp	Fe	11.7	5.0	3.3	57.4	0.0	0.4	5.7	8.3	0.18	0.03	0.15	7.30	0.00	0.00	0.03	0.12	0.09	0.07	0.21	0.02	0.00	nd	0.00
97	SS	SIII	yellow (ss)	tp	Fe	7.3	4.0	5.1	61.1	1.0	0.8	5.0	9.1	0.28	0.02	0.13	5.83	0.00	0.00	0.02	0.01	0.06	0.07	0.23	0.00	0.00	tr	0.00
98	SS	SIII	yellow (ss)	tp	Fe	4.0	3.0	5.7	66.6	0.0	1.9	4.1	7.4	0.31	0.02	0.13	6.23	0.01	0.00	0.05	0.00	0.06	0.06	0.40	0.00	0.00	nd	0.00
99	SS	SIII	yellow (ss)	tp	Fe	10.5	4.5	4.3	57.3	0.2	0.5	5.7	7.9	0.21	0.03	0.08	8.29	0.01	0.00	0.01	0.09	0.08	0.09	0.22	0.00	0.01	tr	0.00
100	SS	SIII	yellow (ss)	tp	Fe	2.6	3.1	3.0	62.6	5.1	0.8	3.9	7.5	0.18	0.03	0.07	10.82	0.01	0.00	0.01	0.05	0.02	0.06	0.10	0.00	0.00	tr	0.06
101	SS	SIII	yellow (gs)	tp	Fe, (Mn, Sb), +Au	4.2	2.8	3.1	73.5	0.0	0.9	4.9	7.7	0.09	0.04	0.85	1.26	0.00	0.00	0.00	0.02	0.09	0.09	0.02	0.00	0.42	tr	0.01
Zamiin Utug GSC1 (cylindrical silver sandwich beads)																												
1	SS	SIII	yellow (ss)	tp	Fe	13.1	4.6	4.8	58.1	0.8	0.1	3.7	8.7	0.21	0.02	0.15	5.43	0.00	0.00	0.05	0.00	0.04	0.05	0.17	0.00	0.01	tr	0.00
2	SS	SIII	yellow (ss)	tp	Fe	10.9	4.0	4.8	60.7	1.2	0.2	4.1	8.0	0.22	0.00	0.15	5.43	0.00	0.00	0.02	0.01	0.07	0.05	0.13	0.02	0.01	tr	0.00
3	SS	SIII	yellow (ss)	tp	Fe	3.5	2.3	4.4	69.4	2.6	0.5	3.7	6.6	0.19	0.02	0.16	6.50	0.00	0.00	0.04	0.02	0.04	0.05	0.11	0.00	0.00	nd	0.00
4	SS	SIII	yellow (ss)	tp	Fe	1.7	2.4	3.0	73.0	2.7	1.0	2.8	4.2	0.11	0.02	0.07	8.55	0.01	0.00	0.08	0.01	0.01	0.05	0.34	0.02	0.00	nd	0.00
5	SS	SIII	yellow (ss)	tp	Fe	3.5	2.4	5.3	63.0	5.2	0.4	3.5	7.9	0.24	0.01	0.15	8.01	0.00	0.00	0.01	0.02	0.05	0.06	0.15	0.00	0.00	tr	0.00
Zamiin Utug E1 (eye beads, total 7 beads)																												
1	F	SIII	light blue	op	cu	5.61	4.09	5.46	68.47	0.00	1.28	3.92	5.88	0.34	0.07	0.02	1.95	0.00	0.00	2.56	0.01	0.03	0.07	0.18	0.00	0.00	nd	0.06
2	F	SIII	light blue	op	cu	4.08	3.96	5.55	67.79	0.00	1.30	4.60	6.69	0.34	0.05	0.12	1.67	0.00	0.00	3.28	0.01	0.01	0.09	0.23	0.00	0.00	nd	0.23
3-1	F	SIII	light blue	op	cu	12.63	7.03	8.37	53.93	0.50	0.60	4.76	6.53	0.27	0.19	0.16	1.90	0.00	0.00	2.21	0.04	0.04	0.17	0.42	0.00	0.00	tr	0.27
3-2		SIII	(dot parts)	op	cu, pb	8.03	2.98	4.87	64.69	0.00	-	4.78	8.22	0.37	0.02	0.12	2.59	0.01	0.00	1.69	0.01	0.04	0.09	0.27	0.13	0.00	tr	1.09