# Analyses of glass from late antique hilltop site Korinjski hrib above Veliki Korinj (Slovenia)

# Analize stekla s poznoantične višinske postojanke Korinjski hrib nad Velikim Korinjem

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**Izvleček**

Analizirali smo vzorce steklenih posod in okenskega stekla s poznoantične utrdbe Korinjski hrib pri Velikem Korinju. Steklene najdbe s tega najdišča, datiranega v 6. st., kažejo značilen, vendar omejen spekter posod, predvsem kozarce brez noge, kozarce na nogi in okensko steklo. Rezultati arheometričnih analiz so pokazali nepričakovane sredozemske sestave steklenih mas, ki nakazujejo, da je bilo najdišče lahko vpeto v bizantinsko trgovsko mrežo ali sistem vojaške oskrbe.

**Ključne besede:** Slovenija; Korinjski hrib; pozna antika; steklo; arheometrične analize

**Abstract**

Samples of glass vessels and window glass from late antique fortification Korinjski hrib near Veliki Korinj, Slovenia, were analysed. The glass assemblage from this 6th c. site shows a typical, but limited set of vessels, which mainly comprises beakers, goblets and window panes. The results of archaeometry analyses showed unexpected Mediterranean glass compositions, indicating that the site may have fitted into the Byzantine trade or army supply network.

**Keywords:** Slovenia; Korinjski hrib; late antiquity; glass; archaeometric analyses

## THE SITE

The archaeological site at Korinjski hrib above Veliki Korinj, southeast Slovenia, was discovered as early as 1886 and systematically researched a hundred years later, in 1982 and 1983. The research was conducted by a team from the Institute of Archaeology ZRC SAZU, led by Slavko Ciglenečki (Ciglenečki 1985). The site is located at 728 m asl, in the karst region of Suha Krajina (*Fig. 1*). The earliest finds date to the late Eneolithic and the Bronze Age, the first habitation remains to the late La Tène period (Dular et al. 1995). Later, several small finds including coins point to the human presence in the 3rd c. AD, while the main settlement phases date to the time after the 4th c. AD. Around 400 AD, the site probably began to serve as a military post and was more permanently settled from the late 5th or first half of the 6th to the end of the 6th c. Several characteristics of the site indicate a pronounced military function. Five towers (two of them also used as water cisterns) and a church of a simple ground plan represent the only architectural remains (*Fig. 2*); as such,

the site shows similarities with other military fortifications in the southeastern Alps, along the east Adriatic coast and the Danube (Ciglenečki 2008, 500–501). Quantity of small finds in the settlement is generally low and does not indicate a large civilian population. The only exception is a relatively large number of fibulae and belt set parts, which could be linked to barbarian and Byzantine garrisons.

As part of a comprehensive study of the site (Ciglenečki, Modrijan, Milavec 2020), several glass finds were analysed in detail. The main research questions of this analysis were how many and which primary glasses were used to produce the vessels and window panes, where they were coming from and what they can tell us about the site and its role in the wider Mediterranean trade network. We were also interested in the comparison with other already analysed sites in Slovenia and Italy. The paper below presents the results of the archaeometric analyses in association with the archaeological context.

## GLASS FINDS

Excavations at the site have unearthed 34 fragments of glass vessels and 56 fragments of window glass. Apart from a few fragments of early Roman vessels, which probably represent residual finds, the glass vessel assemblage is very simple, even for a late antique hilltop site. It consists of a few fragments of cut and mostly fire-rounded rims, a few beaker bases and feet of stemmed goblets (*Figs. 3–4*). There are no identifiable fragments of hanging glass lamps of either shape (with handles or stemmed). Pieces of window glass were mostly found in the church and outside Towers 1 and 3 (*Fig. 2*), suggesting that all buildings had glazed windows and that the inhabitants were using a limited amount of stemmed goblets, beakers and bottles or flasks. This assemblage – though modest – is very typical for late antique sites in the Mediterranean and its immediate hinterland (Milavec 2011, 101, 113).

For the purposes of archaeometric analyses, we took 26 samples (*Figs. 3–4*) that were analysed at the Jožef Stefan Institute in Ljubljana. We strove to cover all periods (early Roman, late Roman, late antique), locations (trenches between towers, inside towers and in the church) and types of glassware (beakers, goblets, flask, window glass, counter/gem).

The analysed sherds from the church (*Fig. 2*) consist of one neck sherd of a flask, one cut rim sherd, one fire-rounded rim sherd, two base fragments of beakers, seven window pane fragments and one counter/gem (*Fig. 4:* 2–4,8–13,16,18–20). The pieces from Tower 1 comprise two fire-rounded rim sherds and one window pane fragment (*Fig. 4:* 21–23), those from Tower 2 consist of one rim sherd of a bottle and two body sherds of a vessel (*Fig. 4:* 24–26), from Tower 3 one window pane fragment (*Fig. 4:* 17), from Tower 5 one goblet foot (*Fig. 4:* 7), from Trench 2 two goblet feet and two fire-rounded rim sherds (*Fig. 4:* 1,5,14,15). The context for one of the sampled goblets is unknown (*Fig. 4:* 6).

## ARCHAEOMETRIC ANALYSES

The analyses were performed using a combined method of proton induced X-rays and gamma rays (PIXE-PIGE). The measurements were made at the Tandetron accelerator of the Jožef Stefan Institute in Ljubljana, using the in-air measuring station. The proton nominal energy was 3 MeV, which decreased to about 2.77 MeV at the target, after passing an exit window of 2 μm thick tantalum foil and about 1 cm thick air gap between the window and target. The induced X-rays were detected by a Si(Li) detector with an 8 μm beryllium window placed at 135° with respect to the proton beam and at a distance of 6 cm from the target. Exact values of both air-gaps were determined from the measurements on the glass standard NIST 620. The X-ray detector was further equipped with a pin-hole filter made of 0.05 mm aluminium foil with a relative opening of about 10%. The exact values of the aluminium foil thickness and relative opening were determined by the least-squares procedure from a series of targets. The detected X-rays enabled the analysis of elements from and including silicon onwards. For lighter elements, notably Na, Mg, Al, we exploited their characteristic gamma rays that were induced by inelastic nuclear scattering with protons. The lines used for analysis were 440 keV for Na, 585 keV for Mg, and 844 and 1014 keV for Al. Among those, the weakest line was that of Mg, which in practice limited the detection limit of MgO to about 0.3%. We further monitored the competing line at 583 keV from the natural background and subtracted its contribution. The induced gamma rays were measured by a 40% intrinsic germanium detector,

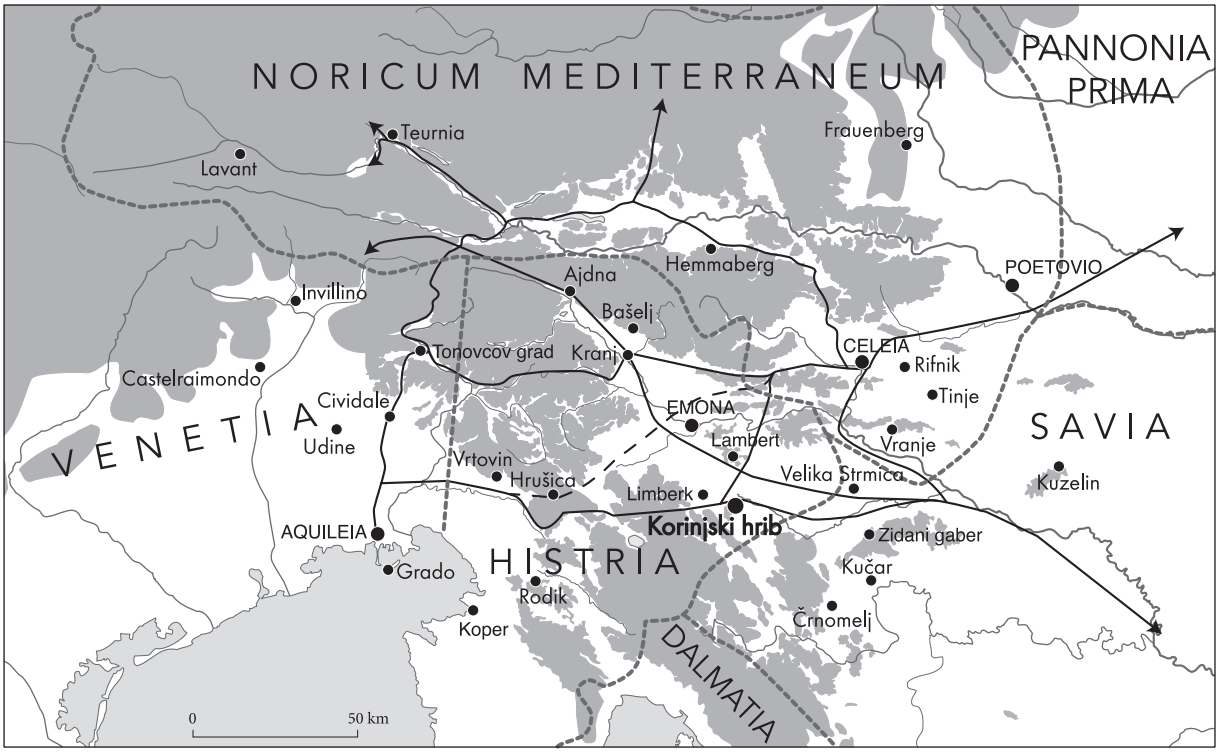


*Fig. 1:* Late antique settlements in Slovenia.
*Sl. 1:* Poznoantične naselbine v Sloveniji.

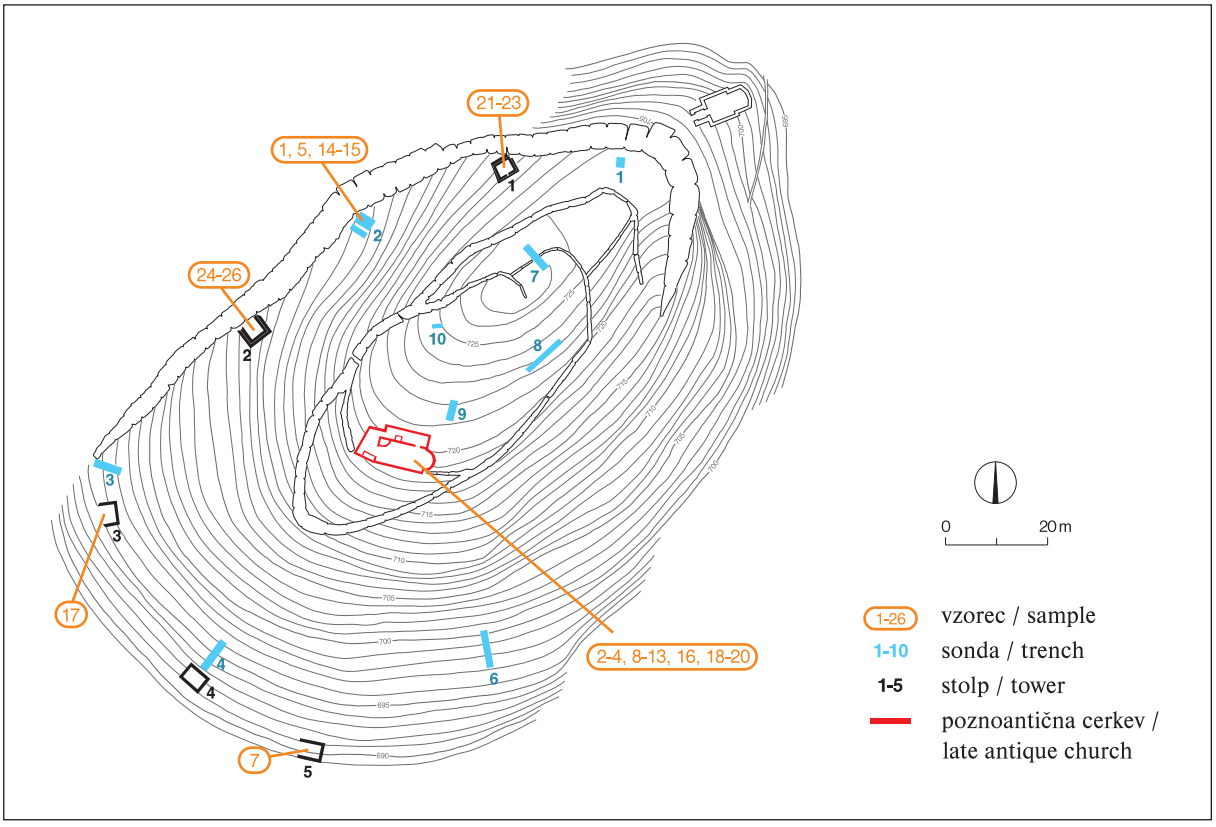


*Fig. 2:* The ground plan of Korinjski hrib above Veliki Korinj. Locations of analysed glass finds.
*Sl. 2:* Korinjski hrib nad Velikim Korinjem. Lokacije analiziranih steklenih predmetov.

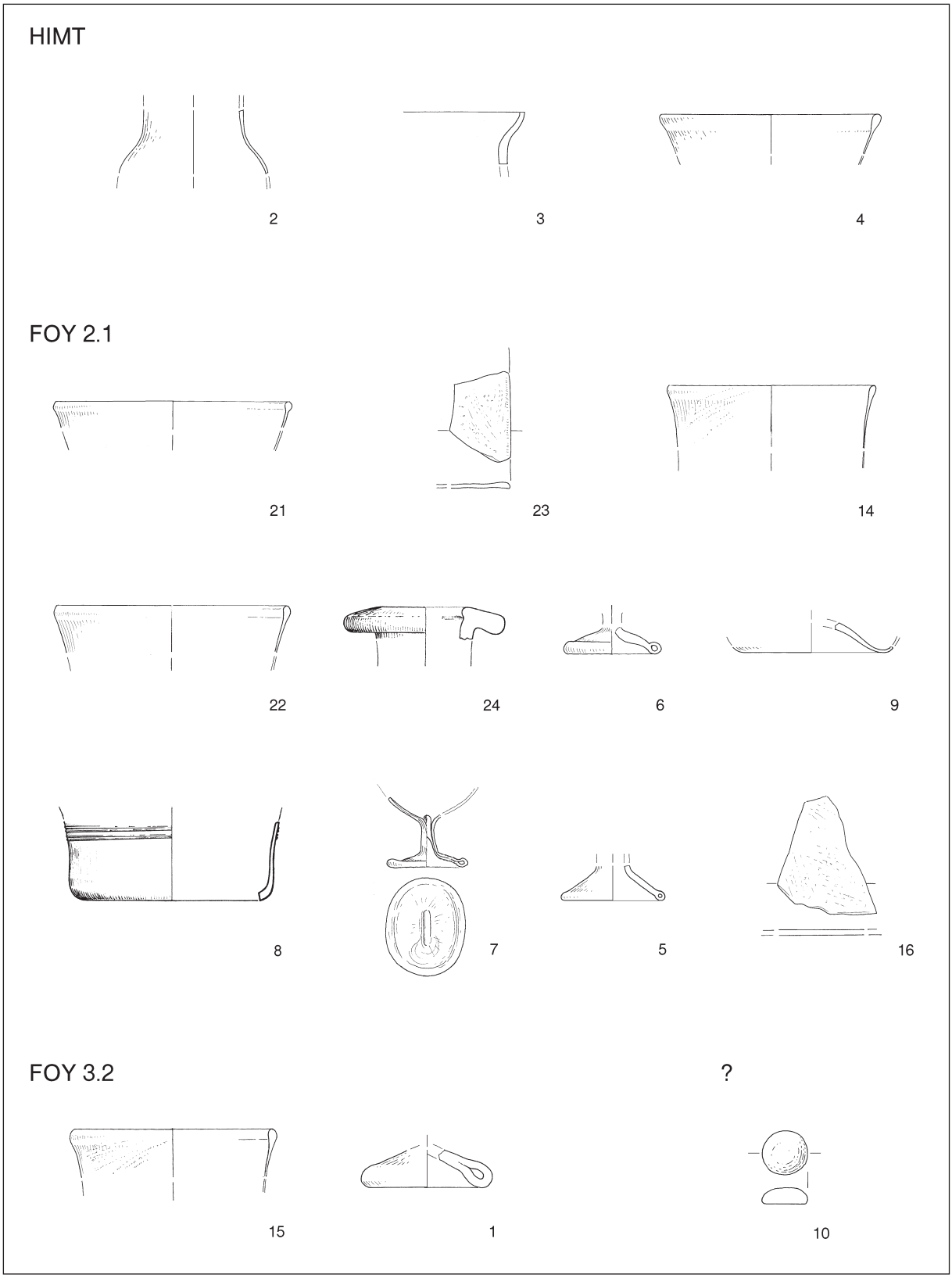


*Fig. 3:* Korinjski hrib. Analysed glass finds (samples 1–26; cf. *Fig. 4*). Scale 1:2.
*Sl. 3:* Korinjski hrib, analizirani stekleni predmeti (vzorci 1–26, prim. *sl. 4*). M. = 1:2.

*Fig. 4:* Korinjski hrib. Table of glass compositions (samples 1–26) in mass % (Na2O-Fe2O3) and µg/g (CuO-PbO).
*Sl. 4:* Korinjski hrib, preglednica sestave stekla (vzorci 1–26) v masnih % (Na2O-Fe2O3) in µg/g (CuO-PbO). →

| Sample | Object | Comp. | $Na_2O$ | MgO | $Al_2O_3$ | $SiO_2$ | $SO_3$ | Cl | $K_2O$ | CaO | $TiO_2$ | $Cr_2O_3$ | MnO | $Fe_2O_3$ | CuO | ZnO | Br | $Rb_2O$ | SrO | $Y_2O_3$ | $ZrO_2$ | SnO | $Sb_2O_3$ | PbO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2** | flask | **HIMT** | 17.2 | 1.38 | 2.47 | 64.9 | 0.39 | 0.92 | 0.62 | 6.87 | 0.37 | 0.008 | 1.89 | 2.91 | 75 | 31 | 6 | - | 443 | 8 | 206 | - | - | 72 |
| **3** | cut rim | **HIMT** | 15.8 | 1.43 | 3.00 | 66.0 | 0.28 | 0.80 | 0.90 | 5.90 | 0.56 | 0.010 | 1.40 | 3.73 | 163 | 56 | 15 | - | 572 | 24 | 410 | - | - | 116 |
| **4** | rim | **HIMT** | 17.8 | 1.46 | 2.51 | 67.5 | 0.41 | 1.04 | 0.45 | 5.98 | 0.30 | - | 1.41 | 1.04 | 69 | 25 | 5 | - | 488 | 7 | 150 | - | - | 44 |
| **15** | rim | **3.2** | 19.4 | 0.65 | 2.09 | 67.5 | 0.68 | 0.76 | 0.61 | 6.62 | 0.11 | - | 0.96 | 0.60 | 80 | 14 | 8 | 6 | 525 | - | 90 | - | - | 37 |
| **1** | goblet | **3.2** | 18.9 | 1.16 | 1.91 | 68.5 | 0.62 | 0.61 | 0.44 | 6.42 | 0.09 | - | 0.79 | 0.52 | 71 | 17 | 9 | - | 573 | 7 | 59 | - | - | 64 |
| **13** | window glass | **3.2** | 18.9 | 1.63 | 2.08 | 65.7 | 0.45 | 0.86 | 0.55 | 7.70 | 0.11 | - | 1.25 | 0.68 | 70 | 18 | 7 | 5 | 699 | - | 59 | - | 154 | 51 |
| **17** | window glass | **3.2** | 18.7 | 1.35 | 2.18 | 64.5 | 0.59 | 0.71 | 0.66 | 9.06 | 0.14 | - | 1.17 | 0.86 | 57 | 19 | 8 | - | 798 | - | 89 | - | - | 41 |
| **18** | window glass | **3.2** | 18.9 | 1.07 | 2.02 | 65.2 | 0.62 | 0.69 | 0.66 | 8.65 | 0.12 | - | 1.15 | 0.89 | 51 | 25 | 5 | 9 | 740 | - | 80 | - | - | 44 |
| **19** | window glass | **3.2** | 18.8 | 1.90 | 2.10 | 65.3 | 0.52 | 0.63 | 0.62 | 8.15 | 0.12 | - | 1.09 | 0.73 | 49 | 25 | 8 | 4 | 652 | - | 92 | - | - | 33 |
| **20** | window glass | **3.2** | 18.8 | 1.37 | 2.06 | 64.6 | 0.65 | 0.66 | 0.64 | 8.96 | 0.14 | - | 1.29 | 0.85 | 64 | 24 | 7 | 6 | 760 | - | 94 | - | - | 39 |
| **26** | vessel | **3.2** | 18.4 | 0.90 | 1.94 | 66.1 | 0.64 | 0.79 | 0.59 | 8.49 | 0.12 | - | 1.23 | 0.69 | 56 | 19 | 11 | 8 | 724 | - | 72 | - | - | 40 |
| **21** | rim | **2.1** | 18.4 | 1.97 | 2.23 | 64.8 | 0.62 | 0.64 | 0.70 | 8.47 | 0.13 | - | 1.13 | 0.80 | 52 | 31 | 7 | - | 704 | - | 95 | - | 201 | 29 |
| **14** | rim | **2.1** | 18.5 | 1.73 | 2.28 | 63.8 | 1.01 | 0.72 | 0.74 | 8.66 | 0.14 | - | 1.33 | 0.94 | 240 | 32 | 6 | 8 | 874 | - | 112 | - | 233 | 85 |
| **22** | rim | **2.1** | 17.8 | 1.35 | 2.34 | 65.6 | 0.50 | 0.64 | 0.84 | 8.42 | 0.14 | - | 1.36 | 0.91 | 61 | 27 | 8 | - | 797 | - | 93 | - | - | 41 |
| **8** | beaker | **2.1** | 18.0 | 1.64 | 2.75 | 66.2 | 0.46 | 0.65 | 0.84 | 6.91 | 0.16 | - | 1.28 | 0.98 | 67 | 39 | 9 | - | 768 | 8 | 127 | - | - | 98 |
| **9** | beaker | **2.1** | 19.2 | 1.12 | 2.47 | 65.4 | 0.57 | 0.77 | 0.58 | 8.12 | 0.15 | - | 0.75 | 0.75 | 42 | 15 | 5 | - | 619 | - | 136 | - | 283 | 52 |
| **24** | bottle | **2.1** | 15.7 | 1.07 | 2.39 | 70.4 | 0.28 | 0.90 | 0.68 | 7.63 | 0.06 | - | 0.51 | 0.34 | 38 | 22 | 4 | 7 | 487 | - | 35 | - | - | 23 |
| **5** | goblet | **2.1** | 17.4 | 1.40 | 3.00 | 62.9 | 0.83 | 0.69 | 0.90 | 10.29 | 0.19 | - | 1.02 | 1.10 | 120 | 54 | 7 | - | 1047 | 13 | 155 | - | 373 | 127 |
| **6** | goblet | **2.1** | 17.4 | 1.51 | 2.29 | 66.2 | 0.59 | 0.64 | 0.79 | 8.11 | 0.13 | - | 1.42 | 0.79 | 119 | 35 | 9 | - | 740 | 11 | 80 | - | - | 122 |
| **7** | goblet | **2.1** | 19.6 | 1.25 | 2.89 | 62.0 | 1.26 | 0.84 | 0.89 | 8.52 | 0.19 | - | 1.38 | 1.12 | 112 | 38 | 10 | - | 799 | 9 | 91 | - | 93 | 117 |
| **25** | vessel | **2.1** | 18.8 | 1.54 | 2.38 | 63.7 | 0.80 | 0.79 | 0.68 | 8.38 | 0.17 | - | 1.66 | 0.95 | 111 | 36 | 0 | 6 | 836 | - | 67 | - | 283 | 16 |
| **23** | window glass | **2.1** | 18.3 | 1.42 | 2.21 | 64.9 | 0.53 | 0.89 | 0.73 | 8.35 | 0.13 | - | 1.55 | 0.85 | 92 | 18 | 9 | - | 749 | - | 76 | - | - | 83 |
| **11** | window glass | **2.1** | 18.1 | 1.40 | 2.18 | 65.4 | 0.50 | 0.75 | 0.88 | 8.39 | 0.13 | - | 1.45 | 0.75 | 55 | 17 | 8 | - | 710 | - | 70 | - | - | 37 |
| **12** | window glass | **2.1** | 17.6 | 1.58 | 2.33 | 65.0 | 0.46 | 0.66 | 0.90 | 8.78 | 0.15 | - | 1.57 | 0.94 | 84 | 25 | 10 | 10 | 894 | - | 157 | - | - | 66 |
| **16** | window glass | **2.1** | 17.7 | 1.44 | 2.25 | 65.4 | 0.47 | 0.69 | 0.83 | 8.54 | 0.15 | - | 1.56 | 0.89 | 76 | 23 | 7 | 4 | 869 | - | 93 | - | - | 44 |
| **10** | counter/gem | / | 12.4 | 0.87 | 5.38 | 61.5 | 1.04 | 0.75 | 2.45 | 8.24 | 0.40 | - | 0.45 | 6.16 | 1975 | 130 | 8 | 97 | 464 | - | 72 | 232 | 408 | 501 |

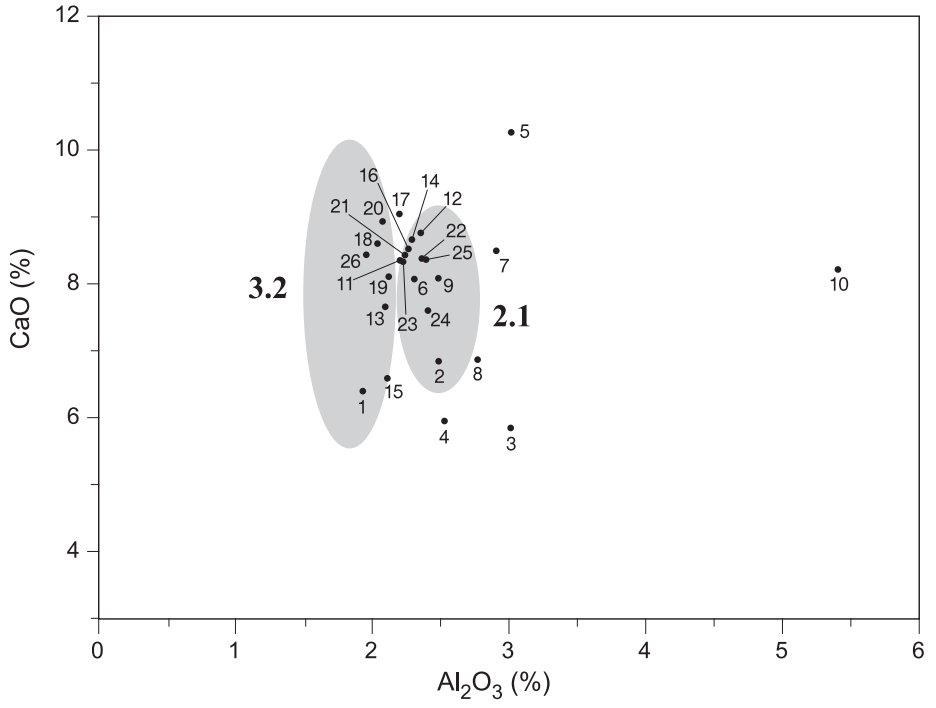


*Fig. 5:* Korinjski hrib. Distribution of the measured glass samples according to the contents of aluminium and calcium oxides. The marked intervals of the 3.2 and 2.1 groups are 2σ ellipses according to the data of D. Foy (Foy et al. 2003).
*Sl. 5:* Korinjski hrib. Porazdelitev izmerjenih vzorcev stekla glede na vsebnost aluminijevih in kalcijevih oksidov. Označena intervala za skupini 3.2 in 2.1 sta podana kot elipsi z dolžino glavnih polosi 2σ glede na podatke D. Foy (Foy et al. 2003).

positioned about 10 cm from the target. The front housing of the detector, made of aluminium, was additionally screened against the scattered protons by a plastic cover. For fitting the spectra, we used the AXIL code for X-rays and a program developed in the lab for gamma rays. For evaluating the concentrations, we used a procedure developed in the lab that considers the matrix effects for induced X-rays and gamma rays simultaneously. The concentrations that follow from X-rays were calculated according to the method of independent physical parameters, while those from gamma rays were determined by the surface approximation according to the values in NIST 620 glass standard, measuring the number of incoming protons by a thin metal mesh intersecting the beam in vacuum. The concentrations were normalized according to the sum of all metal oxides giving unity; however, an additional test was performed according to the argon yield induced by protons in the calibrated air-gap. The sums of metal oxides determined according to the argon yield were allowed to differ from unity by less than 20%; larger differences signalled that the sample was misaligned or had a rough surface. Among the series of 27 measurements, one had the sum of metal oxides of about 1.7; the results of this measurement were removed from the list. Periodic analyses of NIST 620 and 621 standards measured as unknown samples revealed that our concentrations were accurate to within ±5%, while the uncertainties increased to about 10% for concentrations smaller than 0.1%.

## ANALYSES IN ARCHAEOLOGICAL CONTEXT

The analysed glass from Korinjski hrib is roughly attributable to 5$^{th}$–6$^{th}$ c. AD except the cut rim sherd from the church, which is late Roman. Individual finds are typologically and chronologically determined in the monograph (Ciglenečki, Modrijan, Milavec 2020).

The $Al_2O_3$-CaO and $SiO_2$-$Na_2O$ diagrams (*Figs. 5; 6*) show two main groups of glass composition: **Foy 3.2** (*Fig. 3:* 1,15; some not drawn) and **Foy 2.1**. (*Fig. 3:* 5–9,14,16,21–24; some not drawn). In addition, three fragments belong to the **HIMT** group (*Fig. 3:* 2–4): a cut rim sherd, a flask and a fire-rounded rim, all three discovered in the church.

**Foy *série* 3.2** from Korinjski hrib comprises half of the window glass sherds (*Fig. 4:* 13,18–20)

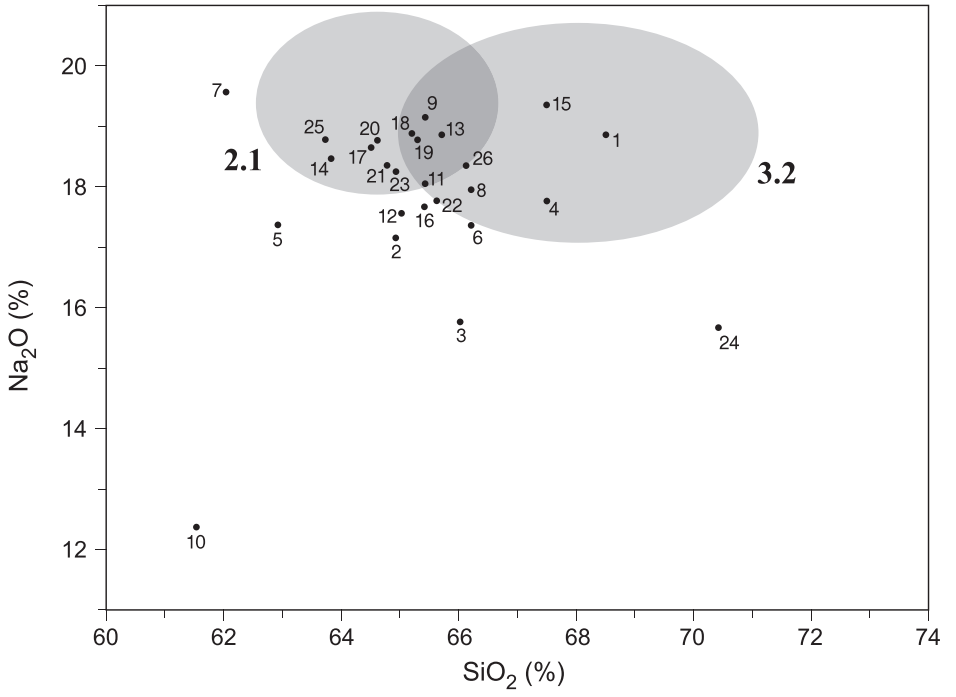


*Fig. 6:* Korinjski hrib. Distribution of the measured glass samples according to the contents of silica and sodium oxide that served as flux. The indicated intervals of the 3.2 and 2.1 groups are 2σ ellipses according to the data of D. Foy (Foy et al. 2003).
*Sl. 6:* Korinjski hrib. Porazdelitev izmerjenih vzorcev stekla glede na vsebnost kremena in natrijevega oksida. Označena intervala za skupini 3.2 in 2.1 sta podana kot elipsi z dolžino glavnih polosi 2σ glede na podatke D. Foy (Foy et al. 2003).

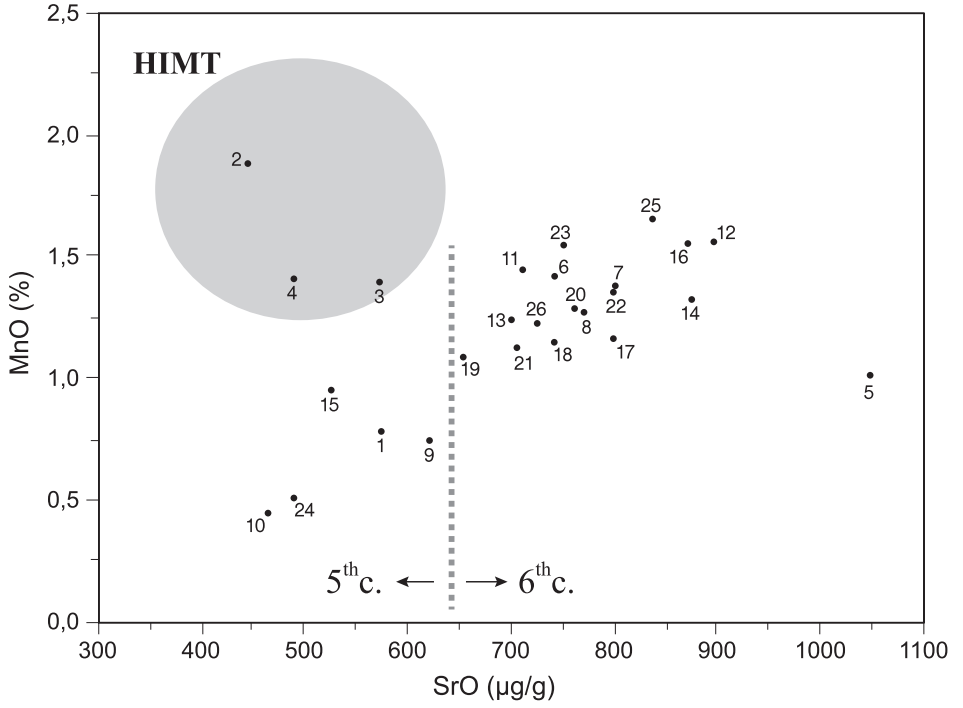


*Fig. 7:* Korinjski hrib. Distribution of the measured glass samples according to the contents of strontium and magnesium oxides. The region of the HIMT glass and the time separation line were deliberately plotted according to the data of A. Cholakova (Cholakova et al. 2015).
*Sl. 7:* Korinjski hrib. Porazdelitev izmerjenih vzorcev stekla glede na vsebnost stroncijevih in magnezijevih oksidov. Območje stekla HIMT in časovna meja sta povzeta po podatkih A. Cholakove (Cholakova et al. 2015)

from the church, a window glass sherd found in Tower 3 (*Fig. 4:* 17), a fire-rounded rim and a goblet foot (*Fig. 4:* 1,15) from Trench 2, as well as a body sherd of a vessel (*Fig. 4:* 26) from Tower 2.

**Foy *série* 2.1** consists of a fire-rounded rim and a goblet foot unearthed in Trench 2 (*Fig. 4:* 5,14), two fire-rounded rims and a piece of window glass from Tower 1 (*Fig. 4:* 21–23), fragments of a bottle and an unidentified vessel from Tower 2 (*Fig. 4:* 24,25), as well as a goblet foot from Tower 5 (*Fig. 4:* 7). Half of the window glass and two beaker bases from the church also belong to this group (*Fig. 4:* 8,9,11–12,16).

The church further revealed a small round glass object (*Fig. 3:* 10; *4:* 10; diam. 1.5 cm) that does not fit in any of the three groups. Too large for a ring bezel intaglio, it may be a game counter or a decorative gem. Its surface is dark and bubbly, probably damaged in the fire that destroyed the church at Korinjski hrib. The colour of the glass could not be established, probably also due to fire damage. Decorative glass gems can be found in basilicas and profane buildings in the East and West, they are red, blue and green and believed to imitate precious stones. Used for decorating various objects and parts of architecture, they substituted the more expensive stones (Antonaras 2018). Due to the generally modest decoration of the late antique churches in the southeastern Alps (Ciglenečki 2003), it is difficult to imagine what the gem from Korinjski hrib could have decorated, perhaps a book cover or a small artefact. Another possibility is that the object represents a gaming token, though these are usually somewhat larger (Cool 2016).

The glass from Korinjski hrib shows no correlation between glass composition and vessel form. There is also no perceptible difference between the glass assemblages from the different buildings within the settlement. The great majority of fragments is of a very similar colour, varying between yellow and green; no specific colour could be assigned to individual glasses. It seems the glasses were used completely interchangeably. It can reasonably be doubted whether the secondary producers, blowers of glass, noticed the difference between the chunks at all. It is possible that the only difference is chronological.

In the 4$^{th}$ and 5$^{th}$ c., **HIMT** is the most strongly represented glass in western Europe. Recent research indicates that it represents the continuation of the 1$^{st}$–4$^{th}$ c. antimony-decolourised glass production, probably located in Egypt, which ceased to be made in the 4$^{th}$ c. (Freestone et al. 2018). A similar situation, with typologically early fragments of the presumably early HIMT glass, was observed at Tonovcov grad (Milavec, Šmit 2018, 356).

The predominance of HIMT in the western Mediterranean and its hinterland in the late Roman period as opposed to the prevailing Levantine I in the 6$^{th}$ c. can be linked to the general characteristics of pottery circulation and foodstuff supply in the region. Evidence shows that the predominant directions of supply changed from north Africa (mainly Tunisia and Mauretania) in the 4$^{th}$ and first half of 5$^{th}$ c. to the eastern Mediterranean (Levant and the Aegean) in the second half of the 5$^{th}$ and 6$^{th}$ c. (Modrijan 2011, 155–158).

The ***série* 3.2** glass was initially dated to the late 5$^{th}$ and early 6$^{th}$ c. by Danièle Foy and colleagues, who posited that it originated in the vicinity of the Belus river (Foy et al. 2003). Recently, is has been convincingly argued that its origin is in Egypt (Schibille et al. 2016; Balvanović et al. 2018). It is a heterogeneous group so far recorded in North Africa, southern France, Britain, Italy (Aquileia, Classe, Padua), the Balkans (Jelica and Caričin grad in Serbia, Butrint in Albania, Bulgaria) and datable between the late 4$^{th}$ and the early 6$^{th}$ c. (Foy et al. 2003; Gallo et al. 2014; Maltoni et al. 2015; Maltoni et al. 2016; Balvanović et al. 2018; Freestone et al. 2018, 162; Cholakova, Rehren 2018).

The **Foy 2.1** glass is slightly later; it spans from the second half of the 6$^{th}$ to the second half of the 7$^{th}$ c. and also originates from Egypt. It has been recorded in western Europe, North Africa, Cyprus and the Balkans (Jelica, Caričin grad, Butrint, Bulgaria) (Foy et al. 2003; Balvanović et al. 2018; Freestone et al. 2018, 162; Cosyns, Ceglia 2018).

There is an interesting blurring of compositional differences between the two glasses, which led Cholakova and Rehren to assume that the primary production of the later 2.1 glass contained recycled 3.2 cullet (Cholakova, Rehren 2018, 64–67). In the case of Korinjski hrib, this assumption is confirmed by the lack of a marked compositional differentiation between the plotted samples (*Figs. 5; 6*).

The chronological distribution according to the SrO-MnO diagram (*Fig. 7*) indicates that most of the 3.2 and 2.1 glass sherds correspond with the glass from the Balkans datable to the 6$^{th}$ century (Cholakova et al. 2015). Only five sherds from Korinjski hrib match the 5$^{th}$ century glass: two 3.2 sherds from Trench 2 (*Fig. 4:* 1,15), two 2.1 sherds from Tower 2 and the church, respectively (*Fig. 4:* 9,24), and the game counter/decorative gem (*Fig. 4:* 10).

The samples that do show a marked difference between types of glass belong to window panes. Considering the chronological difference for the two compositions, we may posit that the church windows at Korinjski hrib were glazed in the first building phase, at the end of the 5th c. Later, in the presumed Justinianic renovation phase, some window panes may have been replaced with those of the later 2.1 glass. On Cyprus, the use of the 2.1 glass in basilicas was also attributed to the Justinianic phase (Cosyns, Ceglia 2018, 86).

## DISCUSSION

The glassware from Korinjski hrib is of three different glasses, all originating in Egypt. The main difference between them at the site appears to be in chronology, starting with HIMT and continuing with *série* 3.2 in the 5th and *série* 2.1 in the 6th c. These chronological differences are not reflected in the typology of the Korinjski hrib glassware, except perhaps the typologically earliest HIMT fragments.

The greatest surprise of the results is that the glasses represented at Korinjski hrib differ from those present at Tonovcov grad near Kobarid, also a late antique hilltop site, but in western Slovenia (*Fig. 1*) (Šmit et al. 2013; Milavec, Šmit 2018). The glass from Tonovcev grad shows similarities with Italian sites in that it is predominantly made of Levantine I glass. Despite numerous similarities between the two Slovenian sites, such as contemporary existence and a strategic location on a hilltop, Korinjski hrib shows a completely different repertoire of glass composition. It also differs greatly from the large distribution centres in Aquileia and Ravenna, with mainly HIMT and Levantine I compositions (Gallo et al. 2014; Maltoni et al. 2015; Maltoni et al. 2016; Maltoni et al. 2018; Silvestri et al. 2018), that are identified as the most probable intermediate points of raw glass trade from Egypt and Syria-Palestine to the Adriatic hinterland.


*Fig. 8:* Sites with the Foy 3.2 and 2.1 compositions in the Balkans (adapted from Balvanović 2018, Fig. 9).
*Sl. 8:* Najdišča s steklom sestave Foy 3.2 in 2.1 na Balkanu (prirejeno po Balvanović 2018, sl. 9).

In glass composition, the glass from Korinjski hrib is rather comparable with that from Serbia and Bulgaria with predominant 3.2 and 2.1 glass compositions (*Fig. 8*; Balvanović 2018; Cholakova, Rehren 2018). Alongside other factors explained below, this seems a compelling argument in favour of the overall military character of the site.

A military character of Korinjski hrib can be inferred from its strategic location, specific architecture (five towers and only a small church) and simple ground plan of the church. As such, it closely resembles the 6th century. fortresses along the Danube limes and the eastern Adriatic (Ciglenečki 2008, 500–501). In addition, the small finds from these sites all share a relatively large percentage of items ascribable to barbarian populations, as well as weapons, belts and fibulae with Byzantine analogies (Ciglenečki, Modrijan, Milavec 2020).

As mentioned above, our results of the glass composition analyses underscore the architectural and artefactual parallels with the Danube region; if Korinjski hrib hosted garrisons of the Byzantine army, perhaps the supply was organized in a similar way to that for the Danubian forts. The results also show a lack of similarities with the sites in western Slovenia and its marked North Italian links.

The architectural and artefactual evidence suggests that the fort on Korinjski hrib was constructed in the (late) 5th c. and renovated in the time of Justinian I in the mid-6th c.; the results of glass composition analyses support this. At other sites, such dating and phasing is corroborated by numismatic evidence (Ciglenečki 2008, 519).

Korinjski hrib is one of a group of sites in southeastern Slovenia that line the route leading eastwards (Zidani gaber above Mihovo, Sv. Lambert near Pristava above Stična, Limberk near Mala Račna; see *Fig. 1*) and show a similarly marked military character (Ciglenečki 2008, 500–501). The glass finds from these sites have not been analysed yet, but it would certainly be very interesting to see the results and consider their implications.

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# Analize stekla s poznoantične višinske postojanke Korinjski hrib nad Velikim Korinjem

*Povzetek*

Arheološko najdišče Korinjski hrib nad Velikim Korinjem v Suhi krajini (*sl. 1*) je bilo odkrito že leta 1886, ekipa z Inštituta za arheologijo ZRC SAZU ga je sistematsko raziskala med letoma1982 in 1983 pod vodstvom Slavka Ciglenečkega. Najdišče je bilo verjetno v uporabi kot vojaška postojanka okrog leta 400 in bolj trajno naseljeno od poznega 5. st. ali prve polovice 6. st. do konca 6. stoletja. Ima kar nekaj značilnosti, ki nakazujejo poudarjeno vojaški značaj. Pet stolpov (dva od teh sta bila uporabljena tudi kot vodna zbiralnika) in cerkev preprostega tlorisa so edine arhitekturne ostaline (*sl. 2*) in kažejo podobnosti z vojaškimi utrdbami v jugovzhodnih Alpah, na vzhodni jadranski obali in v Podonavju. Glavno raziskovalno vprašanje tega prispevka je, koliko in katere primarne sestave steklenih mas so uporabili za izdelavo steklenega posodja in okenskih stekel z najdišča, od kod so prišle in kaj nam lahko povejo o najdišču in njegovi vpetosti v širše sredozemske trgovske tokove.

Med izkopavanji je bilo odkritih 34 odlomkov steklenih posod in 56 odlomkov okenskega stekla. Celo za poznoantično višinsko najdišče je sestava steklenih najdb zelo preprosta. Nekaj odrezanih in predvsem zataljena ustja dopolnjujejo dna in visoke noge kozarcev (*sl. 3*). Prepoznavni deli visečih svetilk, ročaji ali votli tulci, niso bili najdeni. Okensko steklo je bilo odkrito predvsem v cerkvi in zunaj dveh stolpov (stolpa 1 in 3; *sl. 2*). Predvidevamo lahko, da so vse stavbe imele oken-

ska stekla in da so prebivalci uporabljali omejeno količino kozarcev (na nogi in brez nje) ter večjih in manjših steklenic.

Šestindvajset vzorcev (*sl. 3–4*) je bilo odvzetih in analiziranih na Institutu "Jožef Stefan" v Ljubljani. Glede na diagrama $CaO$-$Al_2O_2$ in $SiO_2$-$Na_2O$ (*sl. 5; 6*) so analize pokazale dve glavni vrsti steklenih mas, **Foy 3.2** (*sl. 3:* 1,15; nekateri kosi niso risani) in **Foy 2.1** (*sl. 3:* 5–9,14,16,21–24; nekateri kosi niso risani). Trije odlomki pripadajo vrsti **HIMT** (*sl. 3:* 2–4).

Iz mase **HIMT** so bili izdelani odrezano ustje, odlomek stekleničke in zataljeno ustje, vsi trije najdeni v cerkvi (*sl. 3:* 2–4). Iz mase **Foy *série* 3.2** je polovica odlomkov okenskega stekla iz cerkve (*sl. 4:* 13,18–20), odlomek okenskega stekla iz stolpa 3 (*sl. 4:* 17), zataljeno ustje in noga kozarca (*sl. 4:* 1,15) iz sonde 2 in ostenje posode iz stolpa 2 (*sl. 4:* 26). Iz mase **Foy *série* 2.1** so zataljeno ustje in noga kozarca iz sonde 2 (*sl. 4:* 5,14), dve zataljeni ustji in kos okenskega stekla iz stolpa 1 (*sl. 4:* 21–23), odlomka steklenice in ostenje posode iz stolpa 2 (*sl. 4:* 24,25) ter noga kozarca iz stolpa 5 (*sl. 4:* 7). Druga polovica odlomkov okenskega stekla iz cerkve in dva odlomka dna kozarcev prav tako spadajo v to skupino (*sl. 4:* 8,9,11,12,16).

V cerkvi je bil odkrit tudi majhen okrogel predmet (*sl. 3:* 10*; 4:* 10; premer 1,5 cm), ki ne spada v nobeno od omenjenih skupin. Prevelik je za vložek za prstan, morda gre za igralni žeton ali okrasni kamen.

Med tipom steklene mase in oblikami posod ni bilo mogoče opaziti povezave. Prav tako ni opazne razlike med vrstami steklenih posod iz različnih stavb na naselbini. Večina odlomkov je zelo podobne barve, ki variira med rumeno in zeleno. Nobene barve ni mogoče pripisati posamezni stekleni masi.

Vse tri vrste steklene mase s Korinjskega hriba izvirajo iz Egipta, glavna razlika med njimi na najdišču je očitno v kronologiji. Prva je HIMT, nato *série* 3.2 (v 5. st.) in *série* 2.1 (v 6. st.). Te kronološke razlike se ne zrcalijo v tipologiji posod, razen morda v tudi tipološko najzgodnejših kosih iz mase HIMT.

Največje presenečenje opisane analize je bila razlika med rezultati s tega najdišča in s Tonovcovega gradu nad Kobaridom, poznoantičnim višinskim najdiščem v zahodni Sloveniji. Rezultati so pokazali veliko podobnost z italijanskimi najdišči in večinsko zastopano maso Levantine I. Čeprav sta si najdišči podobni v tem, da sta sočasni višinski točki s strateško lego, ima Korinjski hrib povsem drugačno sestavo steklenih mas. Razlikuje se tudi od velikih distribucijskih centrov v Akvileji in Raveni, ki sta veljali za najverjetnejši vmesni postojanki v prodaji steklene mase med Egiptom, Sirijo in Palestino ter sredozemskim zaledjem. Tam sta zastopani večinoma masi HIMT in Levantine I. Korinjskemu hribu podobne sestave steklenih mas najdemo v Podonavju, Srbiji in Bolgariji (*sl. 8*). Te povezave potrjujejo tudi druge, arhitekturne in artefaktne analogije s Podonavjem. Če je bila na najdišču bizantinska vojska, je bil morda hrib oskrbovan podobno kot podonavske utrdbe. To bi pojasnilo razlike z zahodno Slovenijo in njenimi severnoitalijanskimi povezavami. Analize stekla morda lahko pritrdijo tudi predvideni kronologiji gradnje trdnjave na Korinjskem hribu v poznem 5. st. in prenove v času Justinijana v sredini 6. stoletja, ki je na drugih najdiščih potrjena z novci.

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