Kamnolom apnenca v Podpeči pri Ljubljani in njegovi izdelki

Limestone quarry at Podpeč near Ljubljana (Slovenia) and its products

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Izvleček

Kamnolom v naselju Podpeč pri Ljubljani velja za glavni kamnolom rimske kolonije Emone (Ljubljana). Obstoj antičnega kamnoloma v Podpeči je bil do sedaj utemeljen le na podlagi makroskopske podobnosti med Členom litiotidnega apnenca, ki izdanja v Podpeči, in z njim povezanimi rimskimi spomeniki, odkritimi v Ljubljani. V okviru pričujočega dela smo skušali poiskati oprijemljive arheološke in geoarheološke dokaze za njegov obstoj. V skrajno severnem delu kamnoloma smo izvedli arheološko sondiranje, hkrati pa natančno določili sestavo apnenca na tem območju in v 288 izdelkih iz antične Emone. Sondiranje severno od modernega kamnoloma je odkrilo dobro ohranjene sledove rimskodobne kamnoseške dejavnosti. Hkrati je litološka analiza spomenikov iz Emone razkrila, da je kar 182 (ali 64 odstotkov) analiziranih spomenikov izdelanih iz apnenca, litološko identičnega različkom, ki izdanjajo v Podpeči. Ti različki se prostorsko grupirajo severno od modernega kamnoloma. Pri tem sicer ostaja odprto vprašanje pripadnosti nekaterih različkov apnenca v izdelkih, ki so brez diagnostičnih komponent in bi lahko pripadali tudi nekoliko starejšemu Členu krkinega apnenca. Rekonstrukcijo obsega starega kamnoloma omogoča primerjava faciesov izvornih litostratigrafskih enot in izdelkov, pa tudi historična analiza zgodnjih kartografskih in katastrskih dokumentov. Analiza najzgodnejših izdelkov je omogočila hipotezo o prihodu kamnosekov iz kamnoloma v Nabrežini.

Ključne besede: Slovenija; Podpeč; Emona; rimska doba; Člen litiotidnega apnenca; mikrofaciesna analiza; rimski in novoveški kamnolom; izdelki

Abstract

The quarry in Podpeč near Ljubljana is considered the main quarry of the Roman colony *Iulia Emona* (Ljubljana, Slovenia). The existence of an ancient quarry in Podpeč has been substantiated based solely on the macroscopic similarity between the Lithiotid Limestone Member outcropping in Podpeč and the associated Roman monuments discovered in Ljubljana. In the present work, we have attempted to find tangible archaeological and geoarchaeological evidence for its existence. Archaeological excavations in the form of three trenches were carried out in the northernmost part of the quarry. We determined the lithological composition of limestone discovered in the trenches and the limestone used for the 288 objects found in Ljubljana. The lithological analysis of the monuments from Emona revealed that as many as 182 (or 64%) of the analysed monuments were made of limestone, which is lithologically identical to the types of limestone outcropping in Podpeč. Lithologies represented in monuments also spatially group north of the modern quarry. However, the question of the affiliation of some of the varieties of limestone represented remains open. These limestone types lack diagnostic components and could also belong to the slightly older Krka Limestone Member. Reconstruction of the extent of the ancient quarry was enabled using microfacies comparison of lithostratigraphic source units and objects/products, as well as with the historical analysis of early cartographic and cadastral documents. Studying the forms of the earliest objects (*stelae*) also suggests that the earliest monuments were produced by stonemasons who came to the area from the quarry in Aurisina (Italy).

Keywords: Slovenia; Podpeč; Emona; Roman period; Lithiotid Limestone Member; microfacial analysis; Roman and modern quarry; stone products

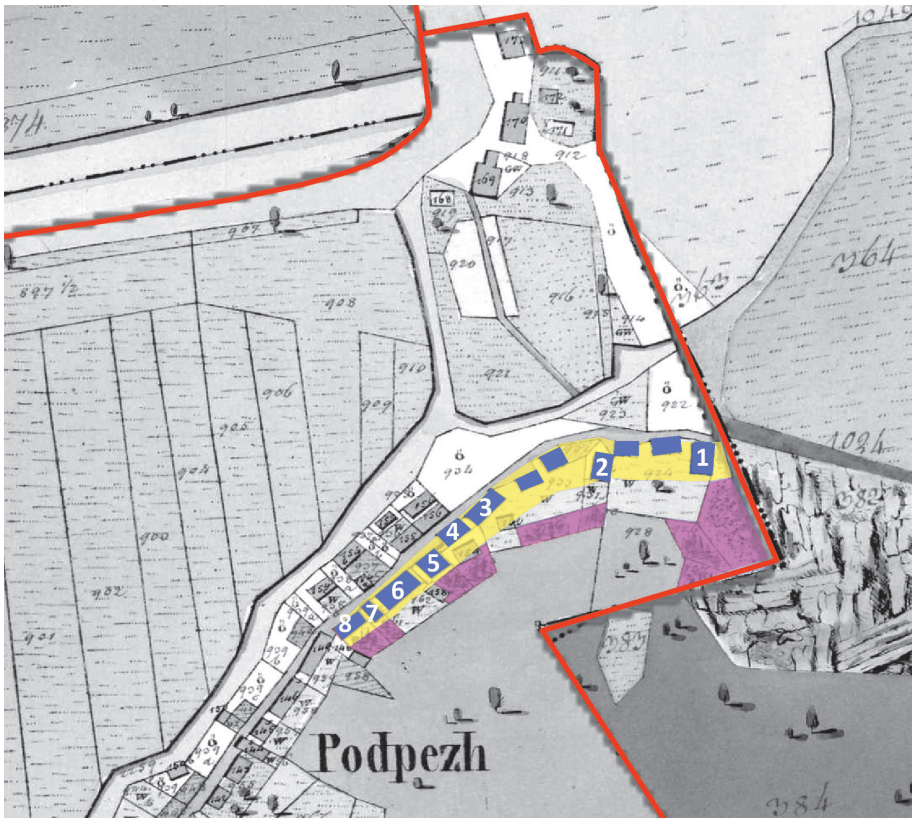
Sl. 1: Šest kmetij naselja Podpeč na prvi vojaški karti 1784–1785.
Fig. 1: Six farms of the settlement of Podpeč on the first Austro-Hungarian military map 1784–1785.
(© Österreichisches Staatsarchiv)

Domneve o rimskodobnem kamnolomu v Podpeči pri Ljubljani se v arheološki literaturi pojavljajo že vsaj od Alfonsa Müllnerja.[1] Pri tem so raziskovalci vseskozi menili, da so novoveške in moderne aktivnosti v njem rimskodobne sledove povsem uničile. Vse do nedavnega[2] je bil rimskodobni kamnolom utemeljevan samo na podlagi makroskopske podobnosti med spodnjejurskim črnosivim apnencem, ki izdanja pri Podpeči, in z njim povezanimi rimskimi spomeniki, odkritimi predvsem v Emoni (mod. Ljubljana). Mikroskopske in druge možne analize podpeškega apnenca, tako v kamnolomu kot v spomenikih, nujne za njihovo nedvoumno povezavo z virom, doslej skorajda niso bile opravljene.[3] Ker na makroskopski ravni nekaterih tipov apnenca ni mogoče ločiti od stratigrafsko nekoliko starejših apnencev, izkoriščanih v drugih domnevnih rimskih kamnolomih, je mikroskopski opis kamnine še toliko pomembnejši.[4] V tem članku želimo predstaviti rezultate litološke karakterizacije različic apnenca (faciesnih tipov oz. faciesov) znotraj Člena litiotidni apnenec na območju podpeškega kamnoloma ter rezultate litološke analize kamnitih spomenikov iz Emone. Natančna določitev faciesnih tipov v podpeškem kamnolomu je postavila zanesljiv temelj za natančne formalne in historične analize podpeške kamnolomske proizvodnje. Hkrati objavljamo rezultate prvega arheološkega sondiranja v kamnolomu, ki potrjujejo rimskodobne kamnolomske aktivnosti na tem kraju, ter topografske ugotovitve analize historičnih virov, povezanih s kamnolomom.

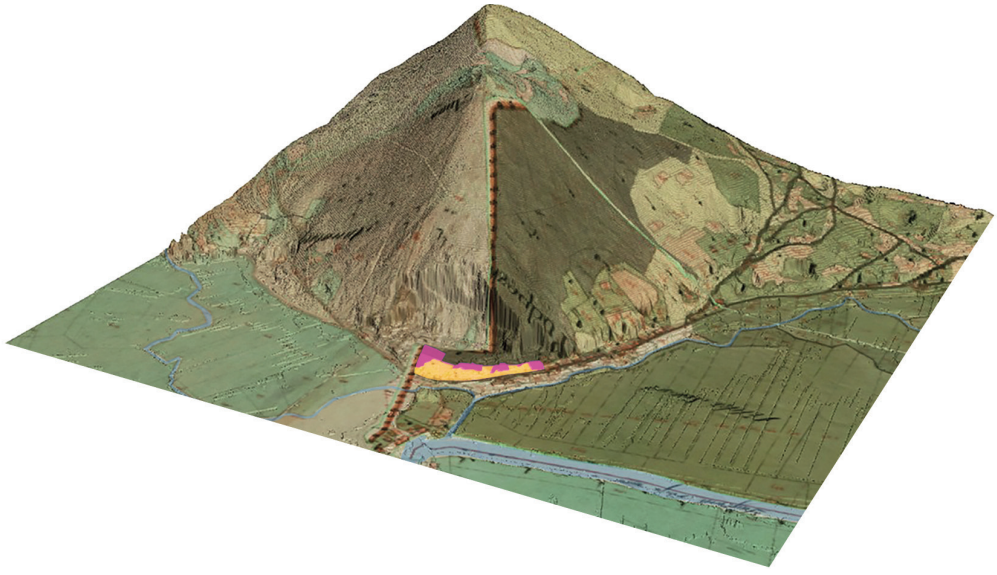
HISTORIČNA TOPOGRAFIJA KAMNOLOMA IN NASELJA PODPEČ

Naselje Podpeč v današnji občini Brezovica pri Ljubljani leži v severnem vznožju hriba Sv. Ana tam, kjer se reka Ljubljanica najbolj približa goratemu južnemu robu Ljubljanskega barja. Krajevno ime Podpeč je sicer slovanskega (slovenskega) izvora, tvorjeno iz imena distinktivne značilnosti lokacije (peč-ina = skala, votlina)[5] in predloga pod (pod--pečjo).[6] To značilnost lokacije, ki je dala kraju ime, navaja v latinski obliki kot Rupes[7] že srednjeveška listina iz leta 1265,[8] ki določa meje posestva

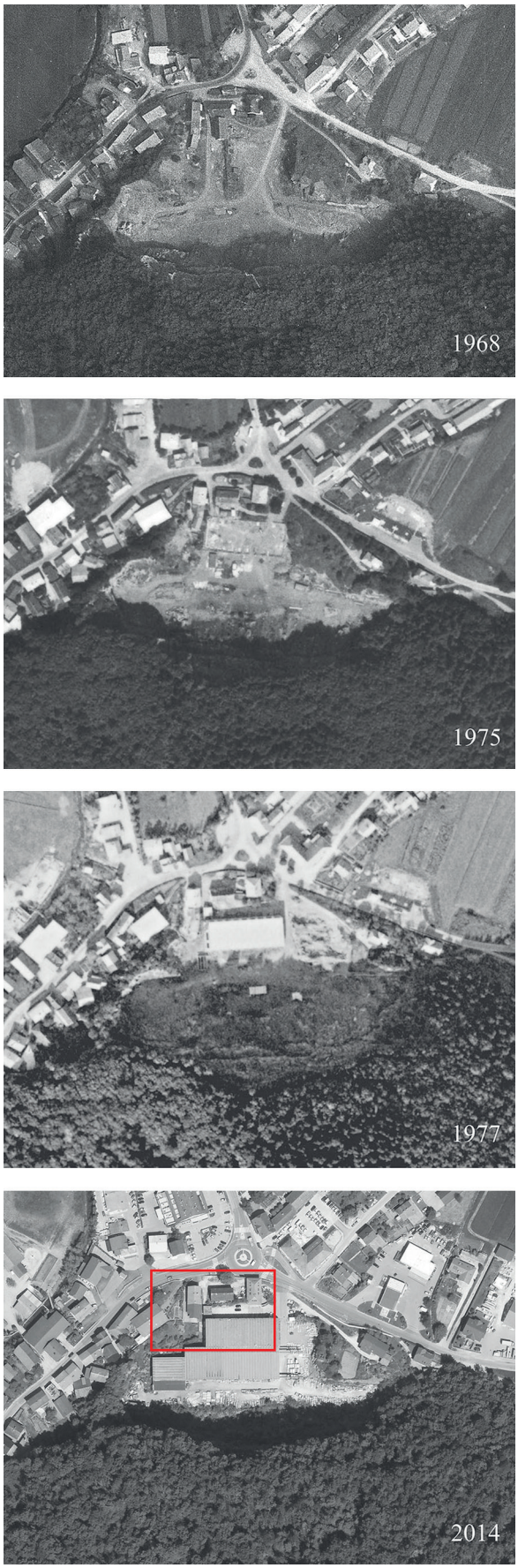
[1] Müllner 1879, 18.
[2] Djurić et al. 2018b.
[3] Za pilotni projekt glej Djurić, Gale, Miletić 2018.
[4] Ramovš 1990.
[5] Glej Snoj 2009, s. v. Pečina.
[6] Glej Snoj 2010, 42–43.
[7] … a rupe quesita est super aquam que descendit in Leybacum. Que rupis est quasi via media a Leybaco in Wreuncz …; Mlinarič 2001, 37 prevaja kot ... pri skali nad vodo.
[8] Kosi et al. 2016, 749; za celotno besedilo glej Chmel 1849, 67–68.



Sl. 2: Naselje Podpeč leta 1823. Meje med katastrskimi občinami so označene z rdečo črto. Označene so kmetije (1–8) z njihovimi kamnolomi (roza) znotraj območja starega kamnoloma (rumeno). [V oglatem oklepaju so današnje hišne št. naselja Podpeč.]
Fig. 2: Settlement Podpeč in 1823. Boundaries between cadastral municipalities are marked with a red line. Farms (1–8) with their quarries (marked with pink) within the old quarry area (yellow). [In square brackets are modern house no. in Podpeč.]
(Osnova / Map: Franciscejski kataster / Franciscan Cadastre. © Österreichisches Staatsarchiv)
1 – Artač [Podpeč 46]; **2** – Svete J. [-44]; **3** – Turk [-41]; **4** – Vodoničar [-40]; **5** – Šenk [-38]; **6** – Svete M. [-35]; **7** – Suhadovnik [-36]; **8** – Makovc [-34]



Sl. 3: Položaj starega kamnoloma (rumeno) in novoveških privatnih kamnolomov (roza) v SZ vznožju Sv. Ane v Podpeči.
Fig. 3: The old quarry area (yellow) and modern private quarries (pink) at the NW foot of Sv. Ana Hill in Podpeč.



(*termini possessiones*) kartuzije Bistra.[9] Poznejše srednjeveške listine navajajo za isti kraj nemško različico imena Vnderm Stain v nekaj oblikah.[10]

Topografsko značilnost, ki je določila krajevno ime, je treba razumeti kot kamnito steno, ki zelo verjetno ni posledica geoloških procesov, saj na celotnem prehodu Krimskega hribovja v južni rob Ljubljanskega barja naravnih kamnitih sten skorajda ni. Kamnito steno je zato treba razumeti kot sled človekovega posega v krajino, kot sled intenzivnega pridobivanja kamna, ki je v kronološkem smislu predsrednjeveško. Glede na kulture, ki so v času pred srednjim vekom na našem ozemlju intenzivno uporabljale kamen za gradnjo in izdelavo uporabnih predmetov, je črpanje kamna v Podpeči mogoče smiselno povezati samo z rimsko kulturo oz. videti na tem mestu večji rimskodobni kamnolom.

Nadaljevanje izkoriščanja kamna na tem kraju je ob odsotnosti neposrednih virov mogoče le domnevati. Prve grajene stavbe, pri katerih bi lahko uporabili tam izklesane bloke, vključno z recikliranimi rimskimi izdelki (stele, are), tako za njihovo gradnjo kot opremo, so v bližini zgrajeni gradovi, cerkve in samostani iz 12. in 13. stoletja – stolpasti Žabji grad enega od spanheimskih ministerialov,[11] romanska cerkev sv. Lovrenca pri Jezeru[12] in stavbe kartuzije Bistra,[13] ustanovljene v letih od 1255 do 1260,[14] vendar nam podatki za srednjeveško (in novoveško) aktivnost v podpeškem kamnolomu niso znani.[15]

[9] Mlinarič 1996, 44.

[10] Vnder dem Stain, Vnderem Stain, Vnder dem Stain, Vnderm Stain; glej Kosi et al. 2016, 749. Stein je sicer tudi nemško ime kraja Kamnik pod Krimom.

[11] Nadbath, Rutar 2008; 2012. Tu sta bila najdena dva napisna kamna: Müllner 1879, 111.

[12] Zadnikar 1982, 537.

[13] Lat. vallis iocosa, nem. Freudenthal. O rimskih kamnitih spomenikih v samostanu glej Müllner 1879, 285–286; Šašel 1960–1961, 188–190.

[14] Marolt 1929; Mlinarič 2001.

[15] Jože Mlinarič (2001, 436) sicer omenja, da je "… *Bistra (je) dobivala kamen v kamnolomu pri Podpeči. Podložniki*

←

Sl. 4: Posnetki cikličnega aerosnemanja med leti 1968 in 2014, ki kažejo glavne moderne spremembe znotraj podpeškega kamnoloma.

Fig. 4: Photos of cyclic aerial photography between 1968 and 2014, showing the main modern changes within the Podpeč quarry.

(© Geodetska uprava Republike Slovenije)

Na tem mestu je pomembno, da je na podlagi listine iz leta 1265 mogoče utemeljeno domnevati, da je ležal celoten kamnolom znotraj meja bistriške posesti na njeni vzhodni meji, s čimer je določena tudi meja kamnoloma na vzhodu. Na tem mestu namreč poteka meja med katastrskima občinama Preserje in Jezero. Na Franciscejskem katastru iz zgodnjega 19. stoletja poteka ta meja v ravni črti približno v smeri sever–jug po sredini hriba Sv. Ana in verjetno odseva mnogo starejša lastniška razmerja.[16] Na skrajnem vzhodnem območju Podpeči kaže katastrska meja odmik od povsem ravnega poteka in izrecno vključuje tedanji kamnolom v k. o. Preserje, medtem ko območje cerkve sv. Ane, ki je sodilo k ižanskemu gospostvu, vključuje katastrska meja, prav tako z odmikom, v k. o. Jezero.

Današnja topografska situacija podpeškega kamnoloma v marsičem briše njegovo zgodnje stanje. Po kartografskih virih sodeč je bilo neznano kdaj, vsekakor pa pred obdobjem med letoma 1763 in 1787, ko je bil izdelan Jožefinski vojaški zemljevid,[17] območje skrajno severnega dela starega kamnoloma razdeljeno na dve kmetiji (*sl. 1*), katerih lastnika sta po franciscejskem katastru iz leta 1823 (k. o. Presser) kmeta Jože Artač[18] in Gregor Turk.[19] V nadaljevanju proti JZ je naselje Podpeč že v času pred obdobjem med letoma 1763 in 1787 obsegalo še štiri kmetije, katerih lastniki so bili (leta 1823): Jože Vodoničar,[20] Tomaž Šenk,[21] Miha Svete[22] in Lovrenc Makovc.[23] Do leta 1823 je nato na prostoru med kmetijama Artač in Turk nastala še mala kmetija, katere lastnik je bil Jože Svete,[24] med kmetijama Miha Sveteta in Makovc pa kmetija Lovrenca Suhadovnika.[25]

Ta parcelna delitev prostora kamnoloma se je ohranila vse do danes, v njem pa so bile skozi čas rušene in grajene različne gospodarske stavbe,[26] medtem ko je večina starih bivalnih stavb vse do danes ostala skoraj nespremenjena. Vse kmetije razen ene so imele na svojih pobočnih parcelah lasten kamnolom (*cava di pietra*)[27] in bile umeščene v prostor mnogo starejšega kamnoloma, kjer so nadaljevale kamnolomske aktivnosti.[28] Očitno je torej, da sta na prvi vojaški karti registrirana dejanski obseg in položaj starega kamnoloma, v katerega se je umestilo šest kmetij, ki so sestavljale naselje Podpeč, ki se je do leta 1823 močno povečalo, vključno s še dvema kmetijama znotraj starega kamnoloma (*sl. 1–3*).

Prostorska razporeditev stavb treh severovzhodnih kmetij, predvsem tistih, ki stojijo v smeri sever–jug (Artač, J. Svete) pravokotno na pobočje hriba, dobro kaže obseg izkopa v starem kamnolomu ob njihovi izgradnji. Ti dve pritlični stanovanjski stavbi sta bili zgrajeni na terasah starega kamnoloma,[29] ki sledijo smeri geoloških plasti, potekajočih vzhod–zahod. Zgrajeni sta bili tako, da sta spodnjo teraso izkoristili za svoje kletne prostore, ki so zavzemali le severni del tlorisov stavb. Stanovanjska stavba kmetije Turk[30] je uporabila enak terasast teren, vendar povsem na zahodnem robu severnega dela kamnoloma. Druge kmetije ob cesti proti jugozahodu so za svoje stavbe verjetno izkoristile manjše in plitvejše kamnolomske posege na tem delu pobočja.

Vzhodno od območja starega kamnoloma, onstran katastrske meje k. o. Preserje, je v k. o. Jezero (Seedorf), na parc. št. 382, nastal velik kamnolom

iz tamkajšnjih naselij (Kamnik, Prevalje, Goričica) so bili dolžni prepeljati obdelan kamen do vode, podložniki iz naselja Pako pa ga nato prepeljati po vodi do kartuzije. …", kar morda odseva, vendar izrecno ne potrjuje, lastništva kartuzije nad kamnolomom.

[16] Leta 1725 dokupi kartuzija Bistra deželnoknežje županstvo Preserje z vasmi Zg. in Sp. Brezovica in Podpeč; Ogrin 1964, 165.

[17] Rajšp, Ficko 1996, sekciji 189, 190.

[18] Giuseppe Artazh, Podpeč 16 /danes 46/, hiša parc. št. 165 in 167, kamnolom parc. št. 925, 926, 927.

[19] Giorgio Turch, Podpeč 15 /danes 41/, hiša parc. št. 161 in 163, kamnolom parc. št. 929.

[20] Giuseppe Votonizhar/Uottonizhar/Ottonitscher, Podpeč 14 /danes 40/, hiša parc. št. 157 in 159, brez kamnoloma.

[21] Thommaso Schenk, Podpeč 13 /danes 38/, hiša parc. št. 158, kamnolom parc. št. 963.

[22] Michele Suete, Podpeč 12 /danes 35/, hiša parc. št. 154, kamnolom parc. št. 962.

[23] Lorenzo Makauz, Podpeč 11 /danes 34/, hiša parc. št. 151, kamnolom parc. št. 960.

[24] Giuseppe Suete, Podpeč št. 24 /danes 44/, hiša parc. št. 164, kamnolom parc. št. 930. Kmetija je verjetno nastala z odkupom parcel kmetije Turk.

[25] Lorenzo Suhadounig, Podpeč 22 /danes 36/, hiša parc. št. 152, kamnolom parc. št. 961.

[26] Gospodarsko poslopje parc. št. 166 je bilo porušeno po drugi svetovni vojni, stanovanjski objekt s parc. št. 165 pa že mnogo prej. Obe stavbi sta pripadali kmetiji Artač.

[27] Za namembnost parcel glej *Protocoll 1824*. Kmetija Artač je imela dve parceli (925, 927) zavedeni kot ghiaja = grušč.

[28] V tem območju domneva Ramovš (2000, 16), ki je glede historičnih podatkov sicer dokaj nezanesljiv, obstoj rimskega kamnoloma "za Prebilovo hišo, hišna številka 10", znanega kot Knezov pruh.

[29] V kleti hiše Podpeč 44 (Svete, danes Vehar) so stare terase kamnoloma še vidne.

[30] Podpeč 41, danes Trček.

v lasti naselja (Ortschaft) Podpeč.[31] Leta 1886 je *Krainische Baugesellschaft*[32] iz Ljubljane kupila kamnolom naselja, ki je bil aktiven že v času gradnje Južne železnice (*Südbahn*).[33] Kmalu zatem je *Baugesellschaft* kupila tudi sosednji kamnolom in hišo[34] Giovannija Comollija, pred tem v lasti Jožeta Artača, kjer se je nato začel razvijati veliki moderni kamnolom.[35] Med letoma 1896 in 1898 so novi lastniki malo nad nivojem mimo potekajoče ceste vsekali v kamnite plasti obsežno teraso,[36] nad njo pa še drugo in na tej postavili rudniške tire za odvoz materiala do nakladališča ob Podpeškem potoku ter za deponiranje jalovinskega materiala na bližnje barjansko območje.[37] Terasiranje in gradnja novih stavb sta ostanke starega kamnoloma v tem delu v celoti odstranila. Po drugi svetovni vojni je bil kamnolom nacionaliziran. Leta 1952 je postal last podjetja Marmor iz Ljubljane, to pa je bilo leta 1977 spojeno s podjetjem Mineral iz Ljubljane. Moderni kamnolom se je širil proti jugu, deloma še proti vzhodu, na zahodni strani pa južno od zasebnih parcel kmetij Svete (danes Podpeč 44) in Turk (danes Podpeč 41) (*sl. 4*) z domnevno dobro ohranjenimi ostanki antičnega kamnoloma.

TERENSKE RAZISKAVE

Georadarske meritve (GPR) in električna upornostna tomografija (ERT) leta 2016

Pred začetkom izkopavanj so bile na predvidenem območju (*sl. 4*) izvedene georadarske meritve (GPR) in meritve upornostne tomografije (ERT).[38]

Za ugotavljanje podpovršinske porazdelitve dielektričnosti in upornosti, ki bi lahko odražali

[31] V obsegu 1 Joch 1457 Klafter (10.989,92 m^2); *Protocoll 1825*. Za delovanje kamnoloma glej Djurić et al. 2018a.

[32] Gradbena družba se je slovensko imenovala *Kranjska stavbna družba*; ustanovljena leta 1873.

[33] *Denkschrift 1898*, 7.

[34] Danes sedež uprave modernega kamnoloma, Podpeč 46.

[35] Leta 1823 je bila parc št. 924 (Presser), kjer leži osrednji del modernega podpeškega kamnoloma, last Jožeta Artača. Njen del je pozneje pripadal "Knezovemu pruhu"(parc. št. 924/2 in parc. št. 984/2), ki ga je kupila Krainische Baugesellschaft (Ramovš 2000). Stanovanjska stavba Jožeta Artača je postala upravni sedež kamnoloma, Podpeč 46.

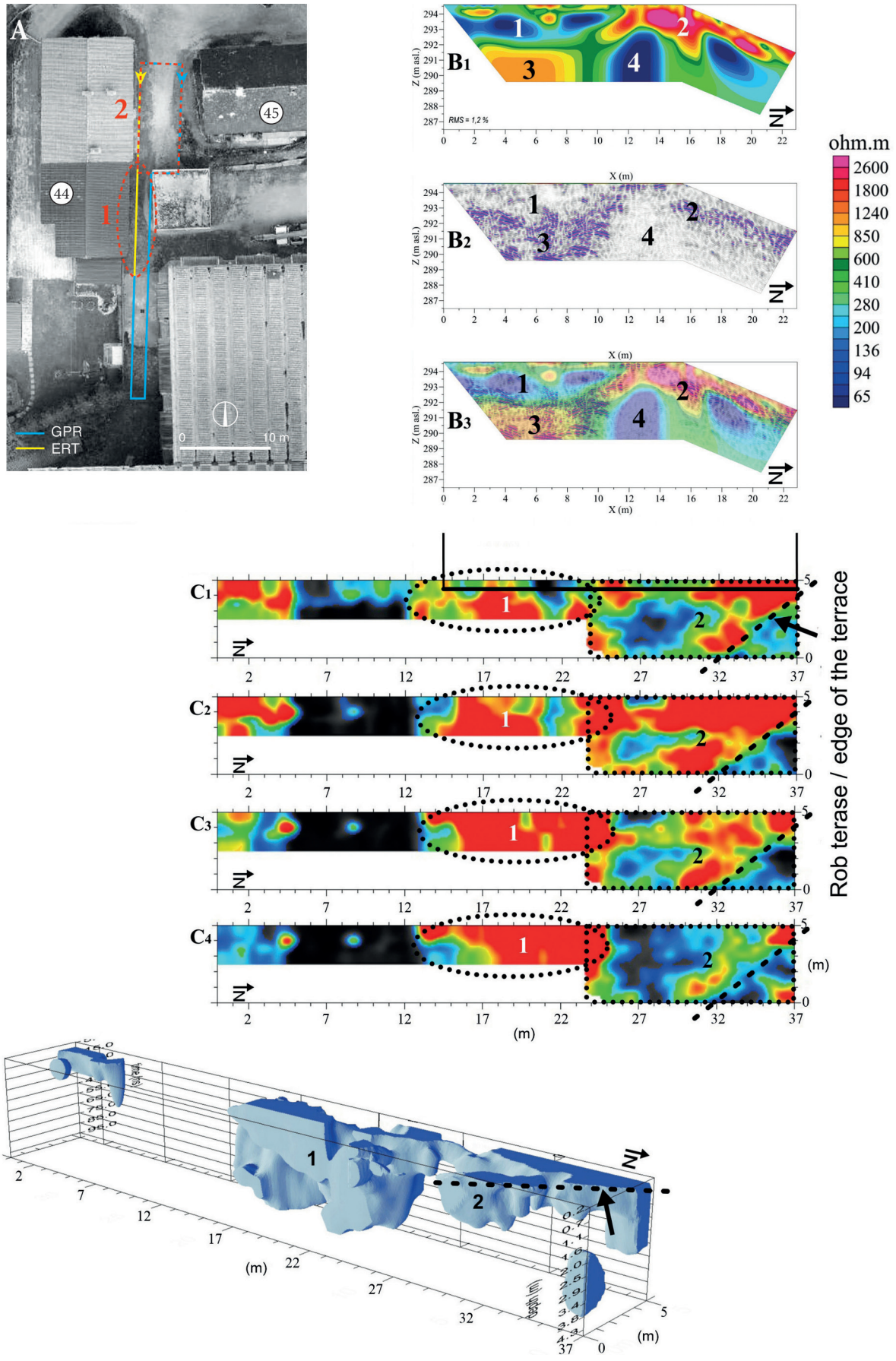
[36] Na njej stoji hiša Podpeč 45.

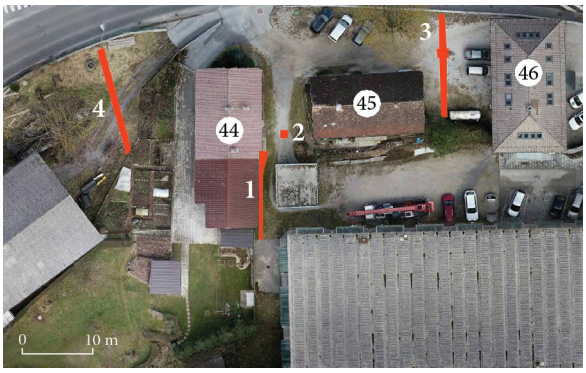
[37] *Denkschrift 1898*, 79–80. Glej tam priloženi Übersichtsplan. Na obsežni zgornji terasi stoji danes velika proizvodna hala, kjer je bila do leta 2020 žaga – gater za naravni kamen.

[38] Raziskava Oddelka za arheologijo Filozofske fakultete Univerze v Ljubljani leta 2016, pod vodstvom Branka Mušiča.

→

Fig. 5: Podpeč. Geofizikalne raziskave leta 2016 (območje poznejših sond 1 in 2).
(**A**) – Območje, raziskano z ERT in GPR. Označen je položaj večje kotanje v apnencu, ki je glede na obliko in velikost najverjetneje naravnega nastanka (**1**) in območje domnevne ekstrakcije apnenca (**2**).
(**B**) – Območji **1** in **2** sta bili določeni na podlagi interpretacije ERT* (B_1: 1, 2, 3 –visokoupornostni apnenec; 4 – nizkoupornostne zapolnitve brezna s peščeno glino) in GPR profila** (B_2: 1, 2, 3 – močni odboji od plasti apnenca; 4 – odsotnost odbojev v zapolnitve brezna s peščeno glino). Upornostne anomalije se na združenem prikazu zelo dobro ujemajo z georadarskimi odboji (B_3).
(**C**) – Na horizontalnih rezih georadarskih odbojev se na različnih globinskih intervalih (C_1–C_4)** jasno prepozna naravna kotanja (**1**) kot razmeroma homogena oblika, medtem, ko je na območju domnevne ekstrakcije apnenca (**2**) zelo heterogena sestava do globine približno 2 m z generalno usmeritvijo roba terase jugovzhod–severozahod (rob terase).
(**D**) – Vse te oblike (**1**, **2** in rob terase) so jasno prepoznavne tudi na tridimenzionalnem prikazu georadarskih odbojev.
Fig. 5: Podpeč. Geophysical survey in 2016 (area of later Trenches 1 and 2).
(**A**) – Position of the area examined by and ERT in GPR. Marked are the positions of the larger depression in the limestone, which by shape and size is most likely of natural origin (**1**), and the area of suspected limestone quarrying (**2**).
(**B**) – The areas **1** and **2** were determined based on interpretation of ERT* (B_1: 1,2,3 – high resistivity limestone; B_1: 4 – low resistivity of sandy clay fills) and GPR profile** (B_2: 1,2, 3 – strong reflections from the limestone layer; B_2: 4 – absence of reflections in the fills with sandy clay). The resistivity anomalies agree very well with the GPR echoes in the combined plot (B_3).
(**C**) – On horizontal sections of the georadar signals at different depth intervals (C_1–C_4)***, the natural depression (**1**) can be seen to have a relatively homogeneous shape, whereas in the area of presumed limestone quarrying there is a very heterogeneous composition down to a depth of about 2 m (**2**), with a general orientation of the terrace edge in direction southeast-northwest.
(**D**) – All these features (**1**, **2** and the terrace edge) are also clearly discernible on the 3D representation of the GPR measurements.
* Inverzni model za elektrodno razvrstitev Wenner-alfa / Inverse model for electrode arrangement Wenner-alpha.
** 270 MHz antena / antenna.
*** C_1: 0,2–0,9 m; C_2: 0,7–1,4 m; C_3: 1,3–1,9 m; C_4: 1,8–2,4 m.


A
2
1
45
44
GPR
ERT
0
10 m
B1
B2
B3
Z (m asl.)
X (m)
RMS = 1,2 %
IN
ohm.m
2600
1800
1240
850
600
410
280
200
136
94
65
C1
C2
C3
C4
Rob terase / edge of the terrace
(m)
D



Sl. 6: Podpeč. Položaj sond 1–3/2016 in 4/2017.
Fig. 6: Podpeč. Position of Trenches 1–3/2016 and 4/2017.

morebitne znake pridobivanja apnenca, so bili profili GPR in ERT nameščeni preko roba umetne terase v smeri S–J (*sl. 5A*). Georadarske meritve so bile izvedene v vzporednih 0,5 m oddaljenih profilih z 270-megaherčno (MHz) anteno, ki zagotavlja ustrezen globinski doseg ob zadostni ločljivosti za prepoznavanje spremenjene morfologije apnenca kot posledice ekstrakcije kamninskih blokov. Za 2D-prikaze georadarskih profilov (*sl. 5B*$_2$ in *B*$_3$) so bili uporabljeni standardni postopki obdelave[39] s programsko opremo ReflexW,[40] 3D-prikaz georadarskih odbojev pa je bil narejen s programom GPR-SLICE (*sl. 5D*).[41] Meritve upornostne tomografije so bile izvedene vzdolž 23,5 m dolgega profila z razmikom med elektrodami 0,5 m in globinskim dosegom ~ 5 m. Uporabljene so bile elektrodne razvrstitve dipol-dipol (DD), Wenner-Schlumberger (WS) in Wenner-alfa (WA) z lastnimi specifičnimi občutljivostmi.[42] Izkazalo se je, da je razvrstitev DD zabeležila preveč okoljskega šuma, kar v mestnem okolju ni presenetljivo, zato je v tem primeru nadalje obravnavana WA, ki je znana po tem, da je med tremi navedenimi najmanj občutljiva za tovrstni šum (*sl. 5B*$_1$). Postopek inverzije je bil izveden z inverzijskim programom ZondRes2D[43] z osredotočeno inverzijo.[44]

[39] Jol 2009.
[40] Sandmeier 2011.
[41] Goodman 2015.

Sl. 7: Podpeč, sonda 1. Polizdelek iz litiotidnega apnenca.
Fig. 7: Podpeč, Trench 1. Semi-finished product made of Lithiotis limestone.

Rezultati

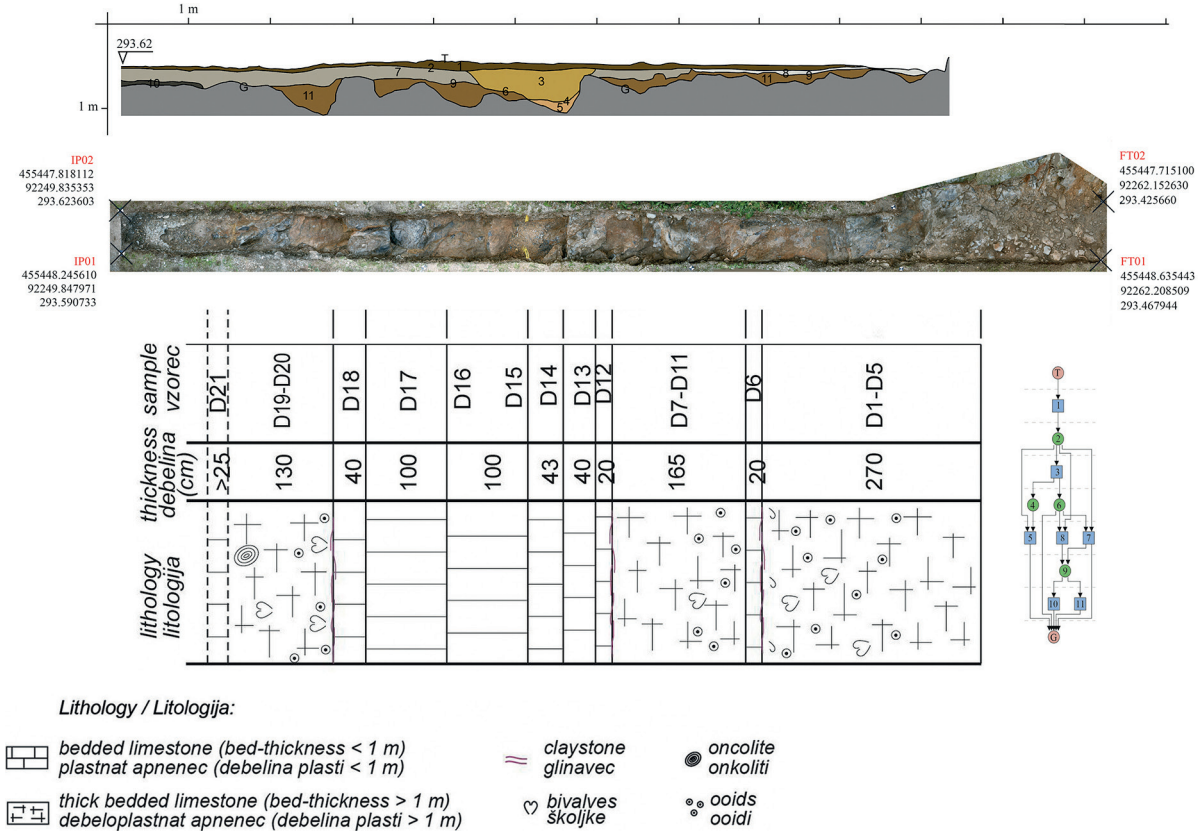
Rezultati upornostne tomografije in georadarskih meritev kažejo zelo podobne podzemne strukture (*sl. 5B*), kjer visoke vrednosti na modelu upornostne tomografije ustrezajo močnim georadarskim signalom, medtem ko se območja z nizko upornostjo ujemajo s šibkimi in odsotnimi georadarskimi signali. Visoke vrednosti upornosti skupaj z močnimi georadarskimi signali so na mestu polkrožne depresije v apnencu na južni polovici profila upornostne tomografije (*sl. 5B:* 1), polnila grobozrnatega materiala z visoko upornostjo pa so lahko skupaj z močnimi georadarskimi signali vzdolž terase indikator sledov pridobivanja apnenca v preteklosti na severnem delu profila (*sl. 5B:* 2). Območja z nizko upornostjo, skupaj s šibkimi ali odsotnimi GPR-signali, so lahko indikatorji naravnega drobnozrnatega polnila brezen (*sl. 5B:* 4) v apnencu (*sl. 5B:* 3).

Sondiranje kamnoloma leta 2016 in 2017

Celotno območje rimskega pridobivanja kamna v Podpeči je danes prekrito s hodnimi in kultiviranimi površinami ter stavbami. V severnem delu kamnoloma zato ni več neposrednega dostopa do plasti apnenca, medtem ko so plasti proti jugozahodu še vidne v stenah na dvoriščnih straneh kmetij. Edina izjema so v severnem delu kamnoloma terasasto oblikovane plasti v mali kleti stanovanjske hiše Podpeč 44 (Vehar). Da bi dobili vpogled v pokrite

[42] Dahlin, Zhou 2004.
[43] Zond geophysical software 2016. *ZONDRES2D – Program for two-dimensional interpretation of data obrained by resistivity and induced polarization methods.*
[44] Portniaguine, Zhdanov 1999.

Sl. 8: Podpeč, sonda 1. Matična kamnina na kateri je zgrajena vzhodna stena hiše kmetije Svete (Vehar), Podpeč 44.
Fig. 8: Podpeč, Trench 1. Bedrock on which the eastern wall of the house of the Svete farm (Vehar) Podpeč 44 is built.



Sl. 9: Podpeč, sonda 1. Zahodni profil s stratigrafsko matriko, fotografija sonde in njen litološki stolpec (glej *sl. 21*). Odvzeti vzorci matične kamnine (D1–D21).
Fig. 9: Podpeč, Trench 1. Western section of the trench, orthophoto and its lithological column (see *Fig. 21*). Samples of bedrock (D1–D21).

plasti apnenca in iz njih pridobili vzorce, ki bi jih bilo mogoče primerjati z rimskodobnimi izdelki, odkritimi v Ljubljani, smo izkopali štiri sonde.[45] Prve tri smo izkopali leta 2016 na prvi in drugi terasi kamnoloma Mineral med stavbama Podpeč 44 in Podpeč 46.[46] Ker zaradi infrastrukture na tem prostoru ni bilo mogoče dobiti sklenjenega zaporedja geoloških plasti, smo na dvorišču kmetije Turk (Podpeč 41) leta 2017 izkopali sondo 4 (*sl. 6*).[47]

[45] Raziskave Oddelka za arheologijo Filozofske fakultete Univerze v Ljubljani leta 2016 in 2017, pod vodstvom Bojana Djurića. Sondo 2 smo zaradi tam potekajoče infrastrukture predčasno opustili.

[46] Pri izkopavanjih so sodelovali študenti Oddelka za arheologijo Filozofske fakultete Univerze v Ljubljani: Matic Hudovernik, Gregor Kočar, Danica Mitrova, Špela Okršlar, Jon Pollak in Denis Rondič.

[47] Pri izkopavanjih so sodelovali: dr. Edisa Lozić, Nuša Kovačič, Špela Okršlar in Gašper Petkošek.

Sonda 1

Sonda širine 0,8 m je bila izkopana od skalne osnove, na kateri je zgrajena vzhodna stena hiše Podpeč 44, proti jugu v dolžini 12,3 m (*sl. 8; 9*). Zemljina nad neravno lomljeno osnovno kamnino je vsebovala prvo zasutje in grobo izravnavo iz večjih in manjših lomljencev, pomešanih z rjavo zemljo.[48] V njej je bila odkrita grobo obdelana plošča – polizdelek iz dekorativnega litiotidnega apnenca (*sl. 7*).[49] Nad to plastjo je bilo položeno nekaj poznejših nasutij.

Izravnava terena kronološko ni nedvoumno določljiva, lahko pa na podlagi dokumentov skle-

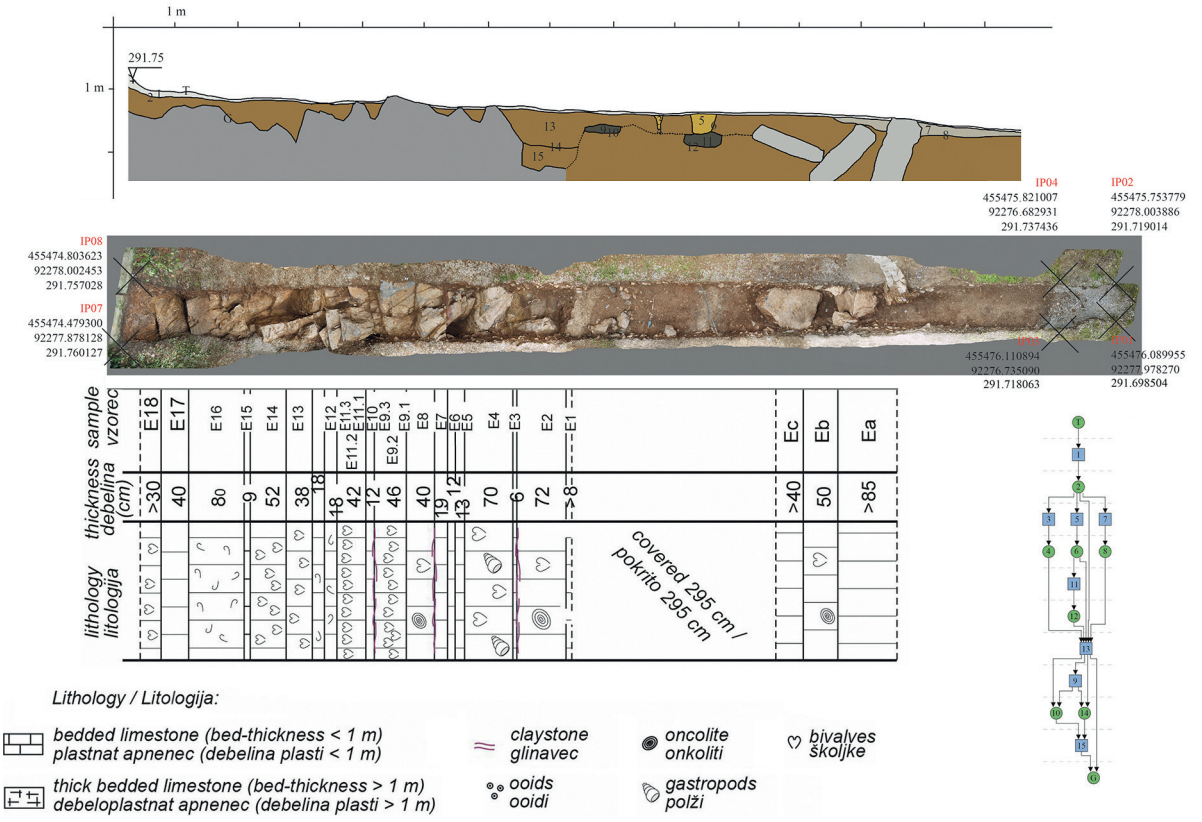
[48] V njej je bilo odkritih nekaj fragmentov novoveške glazirane keramike, nekaj živalskih kosti, dve svinčeni tubi, del stroja, izdelan v ZDA.

[49] Velikost 22 × 26 × 10 cm.

Sl. 10: Podpeč, sonda 3. Zapolnitev brezna v sondi.
Fig. 10: Podpeč, Trench 3. Sink filling in the trench.

Sl. 11: Podpeč, sonda 3. Odrivalnik iz dolomita, polnilo brezna.
Fig. 11: Podpeč, Trench 3. Dolomite guard stone, sink filler.

Sl. 12: Podpeč, sonda 3. Kamnolomski odpadni drobir.
Fig. 12: Podpeč, Trench 3. Quarry spoil from the trench.



Sl. 13: Podpeč, sonda 3. Zahodni profil s stratigrafsko matriko, fotografija sonde in njen litološki stolpec (glej *sl. 21*). Odvzeti vzorci matične kamnine (E1–E18).
Fig. 13: Podpeč, Trench 3. Western section of the trench, orthophoto and its lithological column (see *Fig. 21*). Samples of bedrock (E1–E18).

pamo, da se je to zgodilo najkasneje ob urejanju kamnoloma konec 19. stoletja, ko so bili na tem mestu postavljeni tiri za odvoz kamnitih blokov do rečnega nakladališča.[50] V sondi so bili odvzeti vzorci matične kamnine D1–D21 (prim. *sl. 9*).

Sonda 3

Sonda (usmerjena S–J) širine 0,8 m in dolžine 14 m je bila izkopana na najnižji terasi kamnoloma na dvorišču zahodno od hiše Podpeč 46 (*sl. 13*). V njenem južnem delu je bila grobo izravnana osnovna kamnina tik pod hodno površino. Neravnine so bile zapolnjene z rjavordečo zemljo, pomešano z lomljenci. V njej so bili odkriti redki fragmenti novoveške glazirane keramike in nekaj železnih predmetov. Srednji del sonde zaradi infrastrukturnih vodov ni bil poglabljan in izkop ni dosegel matične kamnine. V nadaljevanju proti severu je bila sonda točkovno razširjena (*sl. 10*). Na tem mestu je kamnita osnova na globini okoli 1 m prešla v večje kraško brezno (lokalno imenovano "vodna"), ki je bilo ob oblikovanju terase zapolnjeno z nekaj večjimi kamnitimi ploščami iz lokalnega apnenca in zasuto. Med ploščami je bil tudi velik, grobo obdelan odrivalnik ("vogalnik"; *sl. 11*), izdelan iz dolomita. Od severnega roba brezna kamnina hitro pada, na njej so bile v več slojih nasute debele plasti odpadnega drobirja kamnolomske proizvodnje (*sl. 12*). V tem drobirju je bil odkrit srebrn avstro-ogrski novec, kovan leta 1849.[51] Plasti odpadnega drobirja tvorijo severni rob pobočja vse do lokalne ceste, kar je bilo potrjeno leta 2012 ob gradnji nove kanalizacijske infrastrukture za celotno naselje.[52] Terasa je bila izdelana ob urejanju kamnoloma konec 19. st., kar bi potrjeval verjetno takrat izgubljeni novec. V sondi so bili odvzeti vzorci matične kamnine E1–E18.

[50] *Denkschrift 1898*, 79–80. Glej tam priloženi Übersichtsplan.

[51] Avstrijsko cesarstvo, Franz Joseph (1848–1916), srebro, 6 krajcarjev, 1849, kovnica Dunaj, Krause 2200. Določitev Peter Kos (NMS).

[52] Neobjavljeno poročilo: D. Češarek in M. Horjak, *Preliminarno poročilo o arheološkem dokumentiranju ob izgradnji kanalizacijskega sistema v ks Podpeč - Preserje, občina Brezovica,* 2012 (hrani arhiv ZVKDS, OE Ljubljana).

Sl. 14: Podpeč, sonda 4, pogled proti jugu.
Fig. 14: Podpeč, Trench 4, view towards south.

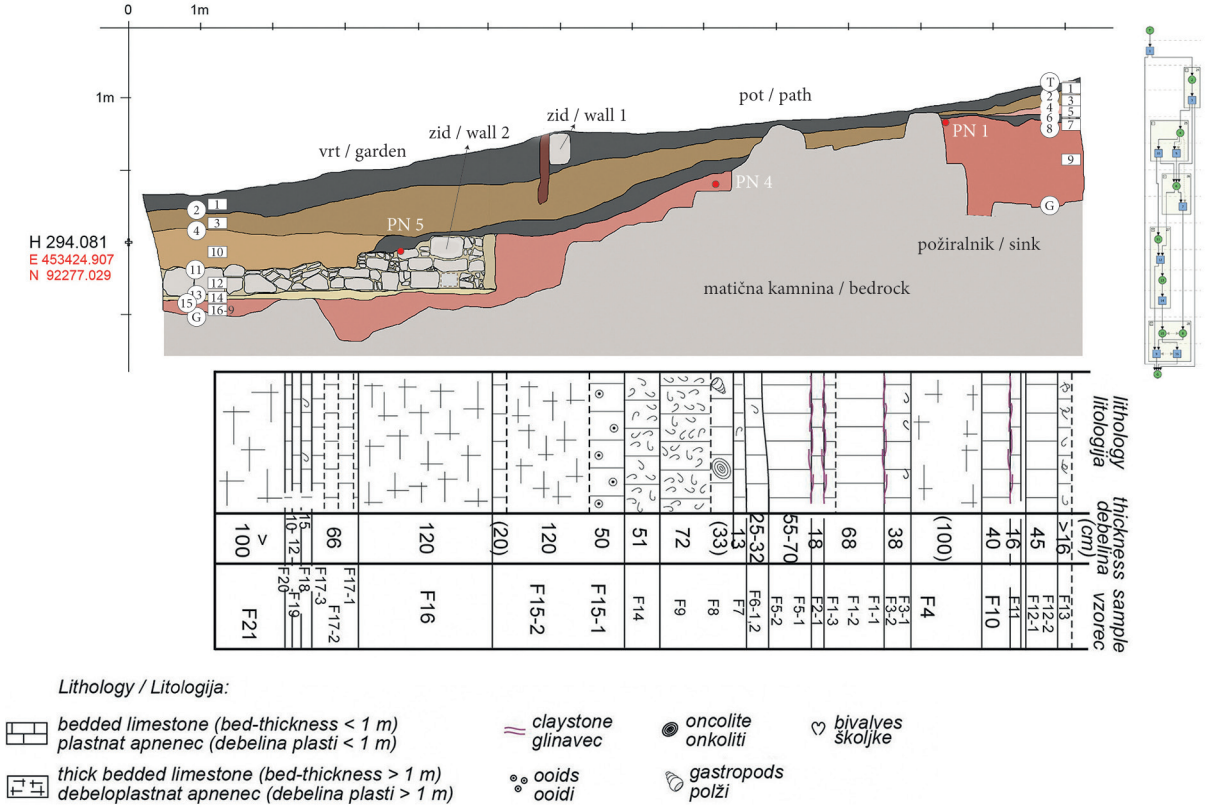
Sonda 4

Sonda (usmerjena S–J, z rahlim odklonom proti Z) širine 0,9 m in dolžine 16,2 m je bila izkopana na parc. št. 932, k. o. Preserje (*sl. 16*). Matična kamnina je v južnem delu sonde segala v hodno površino (*sl. 14*).

Sonda 4 je pokazala stopničasto oblikovano proizvodno površino rimskega kamnoloma, nastalo z lomljenjem blokov po lezikah med subvertikalnimi plastmi kamnine. Načeloma možni žepi za kline, uporabljani za vodoravno lomljenje blokov, v raziskanem delu kamnoloma niso bili ugotovljeni. Na najnižji ugotovljeni terasi je bil odkrit del v psevdo izodomni tehniki zgrajenega zidu stavbe (zid 2; višina do 0,7 m; ohranjena dolžina pribl. 4,5 m, proti severu sega iz sonde) iz pravokotnih apnenčastih lomljencev velikosti 20 do 40 cm, povezanih z apneno malto (*sl. 15*). Zid stavbe je bil ometan z apneno malto. Debeline v smeri sever–jug potekajočega zidu zaradi njegovega položaja v steni sonde in izredno nestabilne plasti nad njim ni bilo mogoče izmeriti. V južnem vogalu ohranjeni sledovi prečnega zidu so imeli debelino 0,6 m. Odkriti del prostora stavbe je imel talno površino prekrito s plastjo mivke, ki je v južnem delu prostora ležala deloma na geološki osnovi in deloma na kamnolomskem drobirju, v severnem delu pa na večjih lomljenih kamnih, ki so zapolnjevali proizvodne neravnine. V skrajnem južnem delu sonde je bil odkrit zasut kraški požiralnik. Višinska razlika med najvišjo točko kamnite osnove na J in najnižjo točko na S znaša 2,4 m. V sondi so bili odvzeti vzorci matične kamnine F1–F21 (glej *sl. 16*). Odkriti del rimskodobnega kamnoloma in ruševina stavbe v njem sta bila zasuta s kamnolomskim drobirjem SE 9 (nem. *Halde*; redki kamni velikosti 20–25 cm, večinoma med 5 in 10 cm in manjši), pomešanim z rdečerjavo ilovnato zemljo. Na površini rimskodobnega zasipa in na vrhu ohranjenega zidu so bili odkriti fragmenti rimskodobnih amfor (*sl. 17; 18;* PN 1–5).

Na ruševini stavbe in na nasipu odpadnega kamnolomskega drobirja z nekaj fragmenti rimske keramike na površini in v njegovem zgornjem delu se je formiral temnorjavi humus SE 7, ki označuje obdobje mirovanja kamnolomskih aktivnosti. Prvo novo aktivnost označuje kronološko nedoločen vkop SE 11 v rimskodobno nasutje, ki je uničil del rimske ruševine. Vkop je bil v nadaljevanju zasut z debelo plastjo kamnolomskega drobirja SE 10, ki nedvomno označuje obnovljeno kamnolomsko aktivnost. Njeno intenzivno nadaljevanje, ki kro-

Sl. 15: Podpeč, sonda 4. Rimskodobni zid 2 v vzhodnem profilu, od 0 do 6 m (prim. *sl. 16*).
Fig. 15: Podpeč, Trench 4. Roman Wall 2 in the eastern section, from 0 to 6 m (see *Fig. 16*).



Sl. 16: Podpeč, sonda 4. Vzhodni profil s stratigrafsko matriko in njen litološki stolpec (glej *sl. 21*). Odvzeti vzorci matične kamnine (F1–F21).
Fig. 16: Podpeč, Trench 4. Eastern section of the trench and its lithological column (see *Fig. 21*). Samples of bedrock (F1–F21).

nološko ni določljivo, kaže debela plast drobirja SE 3 po celotni površini izkopanega območja. Po opustitvi te aktivnosti je na severnem delu prostora na najverjetneje prineseni zemlji nastal vrt, na južnem delu z matično kamnino na površini pa dovozna pot in ob njej skromno zarasla nefunkcionalna površina (SE 1).

Kronološki odnosi plasti zaradi odsotnosti najdb v njih niso določljivi. Fragmenti amfor (*sl. 18*), datiranih v čas od 1. do 3. st., odkriti v rimskodobnem nasutju kamnolomskega drobirja in na njem, ne določajo časa rimske opustitve kamnoloma.

Rezultati sondiranja

Sondi 1 in 3 sta pokazali zadnje terasiranje kamnoloma iz konca 19. stoletja, ki je v celoti odstranilo verjetne sledove rimskodobnega kamnoloma na tem mestu. Sonda 4 je, nasprotno, odkrila povsem ohranjene ostanke rimskega kamnoloma v obliki delovnih teras, nastalih z lomljenjem blokov, in nasutij odpadnega drobirja z delom ruševine rimskodobne stavbe. Sodeč po teh ostankih je upravičena domneva, da so ostaline rimskega kamnoloma zahodno od modernega kamnoloma, pod debelimi nasutji novoveškega in modernega kamnolomskega nasutja, še povsem ohranjene.

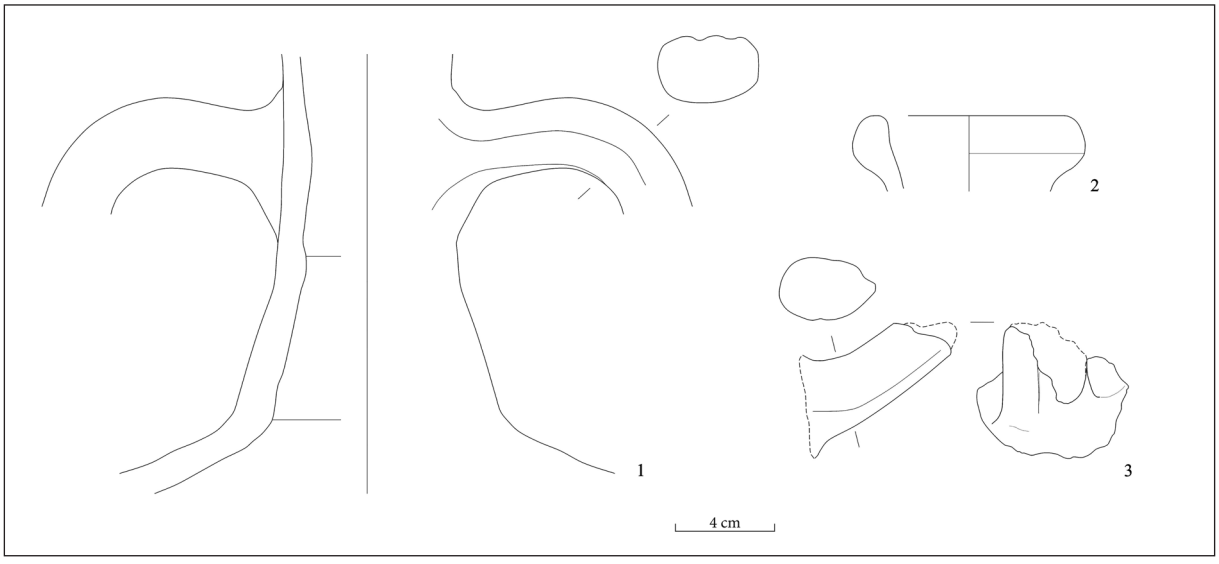
Rimska keramika

PN 1, 2 – sonda 4/SE 09 (*sl. 18:* 1,2):
Odlomki ustja, ročaja in ostenja morda iste amfore z ravnim dnom tipa Forlimpopoli, različica C; keramična masa mehka, finozrnata, redki vključki (drobna ali groba zrnca zdrobljene keramike, drobna zrnca kalcita, zelo fini lističi sljude, fini delci kremena); prelom peščen; barva zunanje površine zelo bledo rjava do rdečkasto rumena (10YR 7/4–7.5YR 7/6); barva preloma rdečkasto rumena (5YR 6/6). Rek. pr. u. 8,5 cm, ohr. viš. 17,5 cm (*sl. 17*). Datacija: od 1., 2. st. do prve polovice 3. st.; proizvodnja se je začela v lončarskih delavnicah regije Emilia Romagna, dokumentirana tudi v Etruriji, Umbriji, Picenumu in v Benečiji; amfore so bile odkrite v severni Italiji, v naseljih in na nekropolah Panonije, v Zgornji Meziji in Daciji, na Kreti, v brodolomih vzhodnega Jadrana.[53]

[53] Panella 2002; Aldini 2000; Jurišić 2000.

Sl. 17: Podpeč, sonda 4. Vrat z ročajem amfore (PN 1) na površini rimskega kamnolomskega nasipa.
Fig. 17: Podpeč, Trench 4. Amphora neck with a handle (PN 1) on the surface of the Roman spoil.

PN 3 – sonda 4/SE 9 (*sl. 18:* 3):
Odlomek ročaja amfore, ovalen presek; keramična masa mehka, finozrnata, redki vključki (fina zrnca zdrobljene keramike, zelo drobna zrnca kalcita, zelo fini lističi sljude); prelom peščen; barva zunanje površine rdečkasto rumena (7.5YR 6/6); barva preloma rdečkasto rumena (5YR 6/6). Ohr. dolž. 3,3 cm, šir. 3,9 cm.
PN 4 – sonda 4/SE 9:
102 odlomka ostenij amfore (keramična masa enako kot pri PN 2) velikosti 0,5 do 3 cm.
PN 5 – sonda 4/SE 9:
3 mali odlomki ostenij amfore (keramična masa enako kot pri PN 2).



Sl. 18: Podpeč, sonda 4. Odlomki amfor: 1,2 (PN 1), 3 (PN 2). M. = 1:3.
Fig. 18: Podpeč, Trench 4. Fragments of amphorae: 1,2 (PN 1), 3 (PN 2). Scale = 1:3.

GEOLOŠKE LASTNOSTI KAMNOLOMA

V geološkem smislu pripada širše območje Podpeči strukturno tektonski enoti Zunanjih Dinaridov, natančneje Hrušiškemu pokrovu.[54] Stratigrafsko zaporedje Krimskega hribovja (*sl. 19; 20*) je v največji meri sestavljeno iz zgornjetriasnih, spodnje- in srednjejurskih plitvomorskih karbonatnih kamnin.[55] Po terminologiji, ki sta jo vpeljala Dozet in Strohmenger,[56] gre za zgornjetriasno formacijo Glavnega dolomita, spodnjejursko Podbukovško formacijo ter srednjejursko Lazensko formacijo.[57] Na območju kamnoloma v Podpeči in njegovem zaledju, hribu Sv. Ane, nastopata zadnji omenjeni formaciji.

Za formacijo Glavnega dolomita je značilno menjavanje dolomitnih plasti, ki odsevajo sedimentacijo v plitvem morju in plimski ravnici. Značilne so valovite lamine (stromatoliti).[58]

Spodnjejurska Podbukovška formacija je razdeljena na štiri člene. Stratigrafsko najnižji je svetlo sivi Člen krkinega apnenca, za katerega so značilni

[54] Placer 2008.

[55] Buser, Grad, Pleničar 1967; Buser 1968; Miler, Pavšič 2008.

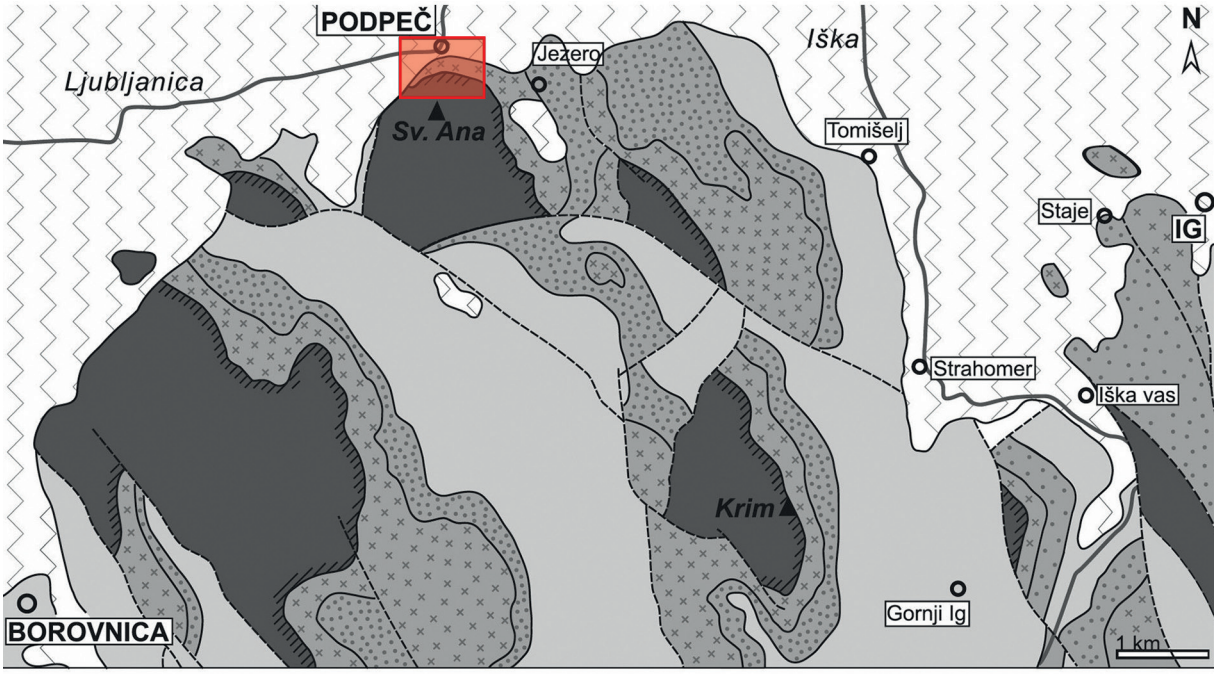
[56] Dozet, Strohmenger 2000.

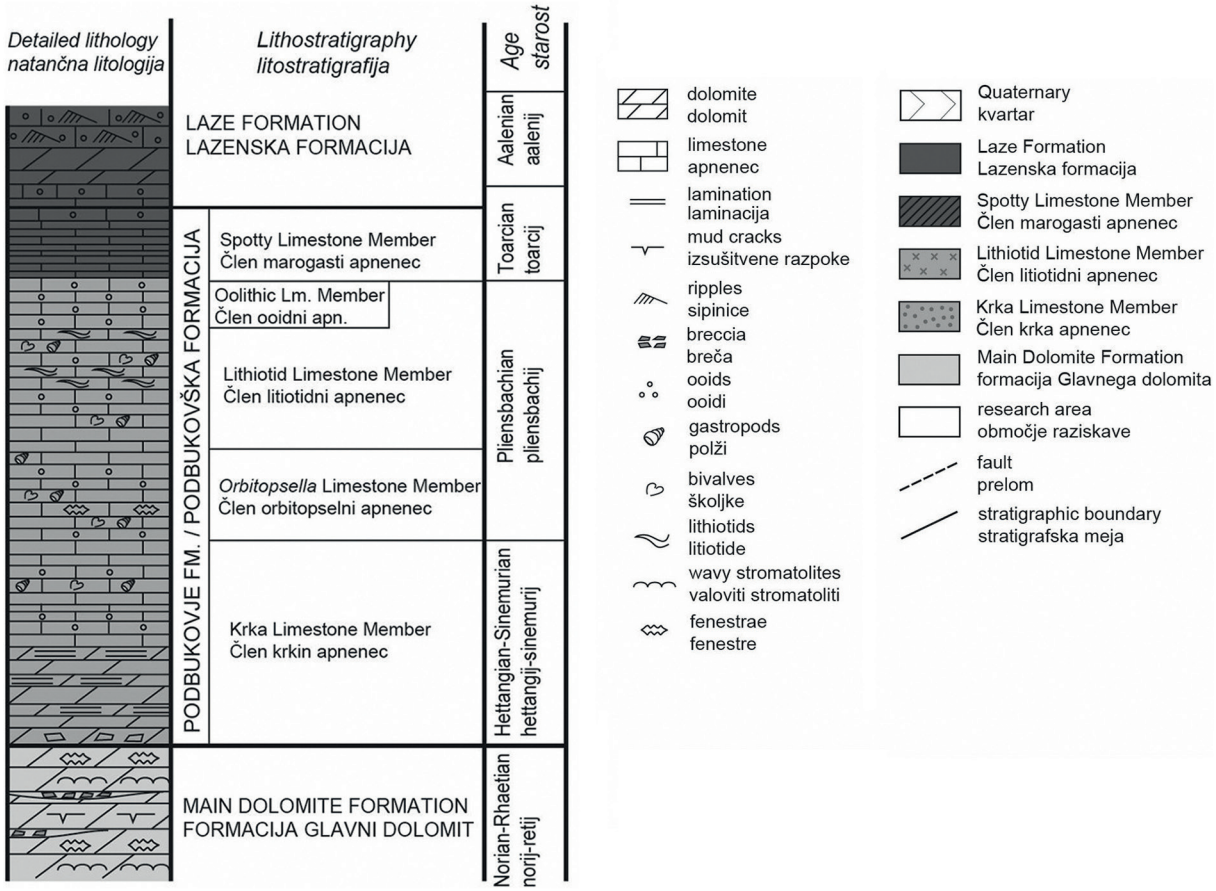
[57] Gale, Keleman 2017, sensu Dozet, Strohmenger 2000.

[58] Miler, Pavšič 2008.

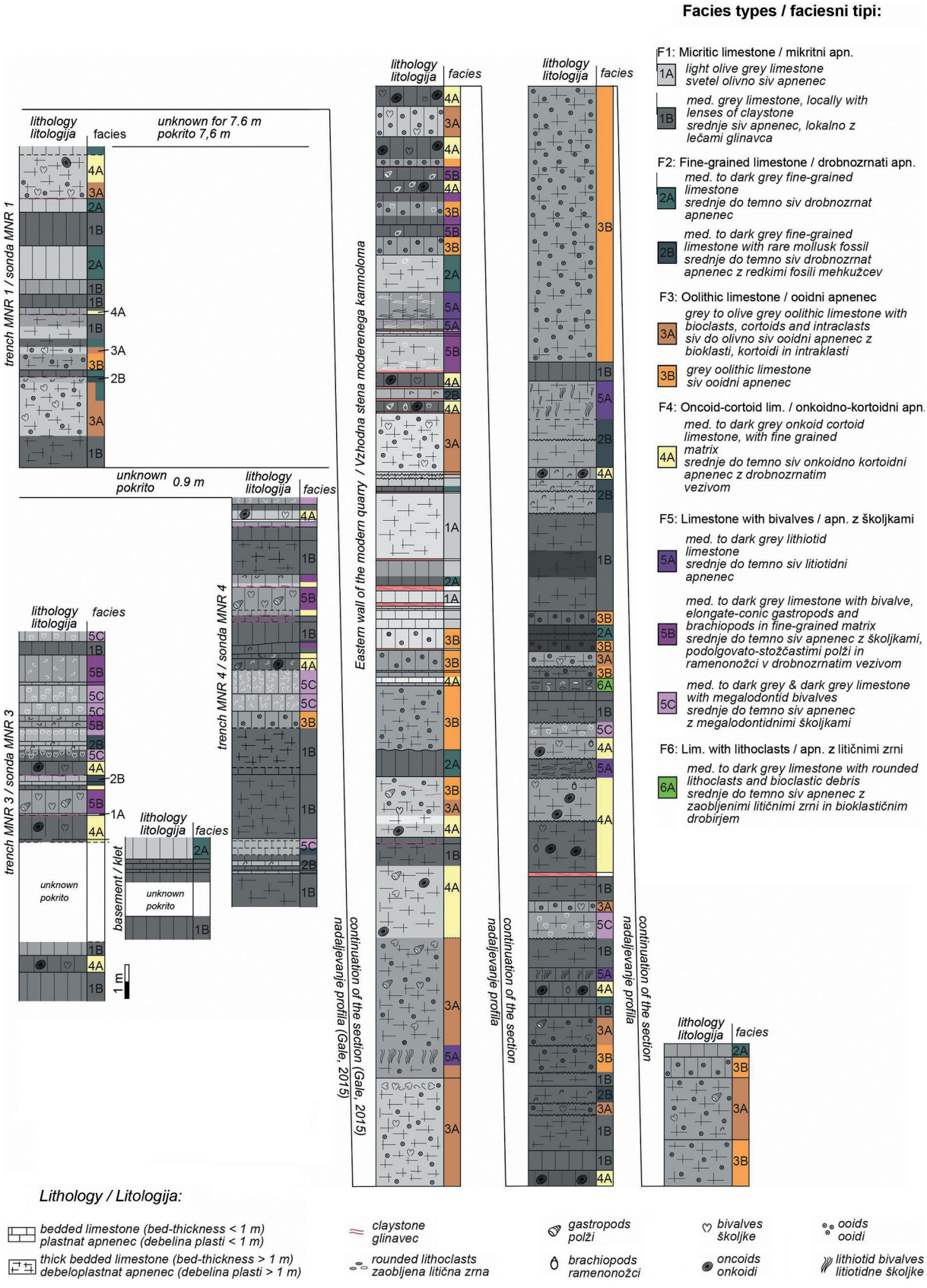
Sl. 19: Litostratigrafska delitev bližnje okolice kamnoloma v Podpeči z označeno lego sedimentoloških profilov. Bela puščica prikazuje stratigrafski potek zaporedja od starejšega proti mlajšemu delu. Belo so označene sonde 1, 3 in 4 leta 2016/2017.

Fig. 19: Lithostratigraphic division of the vicinity of the quarry in Podpeč with marked locations of the sedimentological sections. The white arrow shows the stratigraphic direction of the succession from the older to the younger part. Trenches 1, 3 and 4 in 2016/2017 are marked in white.

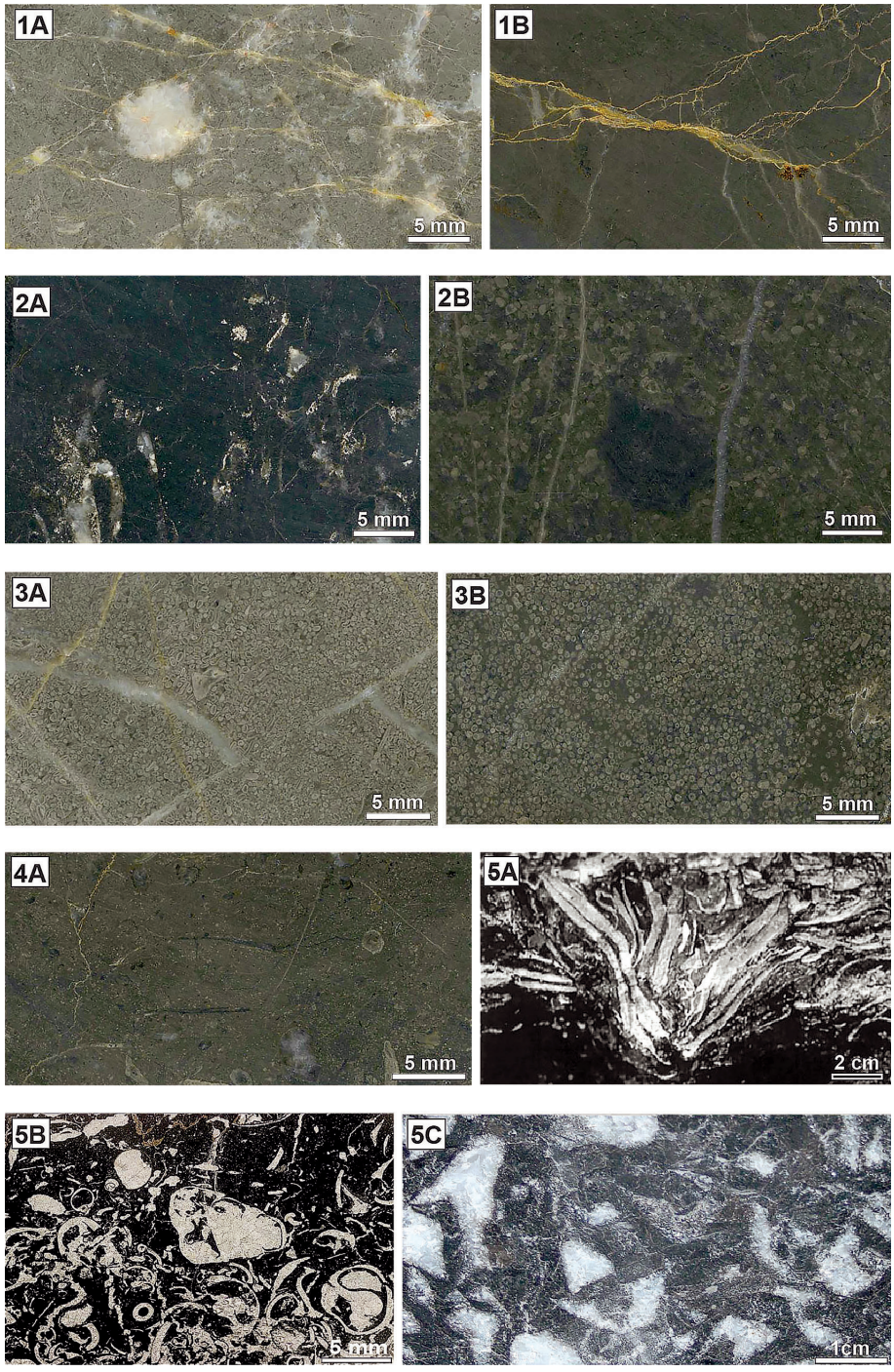




Sl. 20: Geološka karta in stratigrafski stolpec širšega območja Podpeči. Rdeče označen je izsek na *sl. 19*.
Fig. 20: Geological map and stratigraphic column of the wider Podpeč area. The red-marked section in *Fig. 19*.
(Prilagojeno po / Adapted from Buser, Grad, Pleničar 1967; Buser 1968; Dozet, Strohmenger 2000)



Sl. 21: Sedimentološki profil Člena litiotidnega apnenca na območju podpeškega kamnoloma s faciesnimi skupinami (F).
Fig. 21: Sedimentological section of a Lithiotid Limestone Member in the area of the Podpeč quarry with facies types (F).



Sl. 22: Podpeški kamnolom. Slike pogostih faciesnih tipov (definiranih na *sl. 21*).
Posnetek **5A** (fotografiran v stavbi Narodne in univerzitetne knjižnice v Ljubljani) zgolj prikazuje litiotidne školjke. Čeprav vzorec izvira iz Podpeči, tam nastopajo tudi svetlejši različki tovrstnega apnenca. Drugi vzorci izvirajo iz sond v kamnolomu v Podpeči: značilna zrna za ta del zaporedja so onkoidi in ooidi (**3A** in **4A**), litiotidne školjke (**5A**), školjke in podolgovato-koničasti polži (**5B**), rekristalizirane megalodontidne školjke (**5C**), ter do neke mere tudi tangencialni ooidi (**3B**).

Fig. 22: Podpeč quarry. Common facies types (defined in *Fig. 21*).
Photo **5A** (was taken in the building of the National Library in Ljubljana) and only showed lithiotid shells. Although the stone originates from Podpeč, there are also light-coloured types of this limestone. Other samples come from archaeological trenches in the Podpeč quarry: Characteristic grains for this part of the succession are ooids and oncoids (**3A** and **4A**), lithiotid bivalves (**5A**), elongate conical gastropods and brachiopods (**5B**), recrystallised megalodontid bivalves (**5C**), and partly tangential ooids (**3B**).

znaki medplimskih okopnitev in prevlada gostega apnenca brez fosilov in drugih klastov.[59] Navzgor se postopoma povečuje delež ooidov in bioklastov (zlasti lupin školjk in polžev), tako da predstavlja v naslednjem Členu orbitopselnega apnenca poleg prej omenjenega mikritnega apnenca pogost litološki različek zlasti ooidni apnenec. Poleg večjega deleža ooidov lupinaste zgradbe in prvega pojava fosilne luknjičarke iz rodu *Orbitopsella* so za ta člen še vedno značilni zelo svetli odtenki sive barve. Na prehodu proti Členu litiotidnega apnenca postanejo pogostejši temnejši bioklastični apnenci, ki skupaj z ooidnimi različki dominirajo. Med bioklasti v Členu litiotidnega apnenca nastopajo lupine školjk, polžev, ramenonožcev, raznolike luknjičarke in drugi fosili. Zlasti značilne so školjke iz skupine litiotidnih školjk in manjše megalodontidne školjke. Obe skupini školjk se pojavljata v več nivojih in plasteh. Pogosta so tudi obrasla ali bioerodirana zrna – onkoidi in kortoidi. Po Dozetu in Strohmengerju Člen litiotidnega apnenca ponekod navzgor in bočno prehaja v Člen oolitnega apnenca. Podbukovška formacija se konča s ploščastimi do tankimi plastmi temnega in gostega apnenca z redkimi ploščicami iglokožcev. Ta del je imenovan tudi Člen marogastega apnenca, ki postopoma preide v srednjejurske ooidne apnence Lazenske formacije. Za njih so značilni razmeroma veliki ooidi, ki imajo vsaj deloma žarkovito zgradbo, v primerjavi z zadnjimi tremi členi Podbukovške formacije pa je tudi barva apnenca svetlejša.[60]

Od omenjenih formacij in členov izdanjata v podpeškem kamnolomu Člen litiotidnega apnenca, tik za kamnolomom pa še Člen marogastega apnenca ter ooidni apnenci in dolomiti Lazenske formacije (*sl. 19*). Člena ooidnega apnenca v kamnolomu nismo izdvojili od Člena litiotidnega apnenca, saj debele plasti ooidnega apnenca nastopajo tudi med plastmi z litiotidami, hkrati pa se na nekaterih drugih lokacijah (npr. v bližini Krke v Suhi krajini) litiotide pojavljajo vse do stika s Členom marogastega apnenca.

Izmed vseh naštetih enot je najbolje preučen prav Člen litiotidnega apnenca.[61] Nekoliko natančnejše nastopanje faciesov v Podpeškem kamnolomu je podal Ramovš,[62] podrobnejša mikrofacielna analiza pa je bila opravljena v severnem delu modernega kamnoloma.[63] Plasti apnenca v Podpeškem kamnolomu vpadajo skoraj navpično proti jugu in se raztezajo v smeri vzhod–zahod. Poleg plastnatosti apnenca smo izmerili tudi več setov različno usmerjenih razpok, ki najpogosteje ležijo prečno na plastnatost. Z vidika pridobivanja kamna na tem območju pomeni tovrstna situacija v proizvodnem smislu ugodno lastnost, saj je zaradi pravokotnega sekanja ravnin plasti in razpok kamnina pogosto že naravno nalomljena na večje bloke.

Litološka variabilnost tipov apnenca, ki je bila zaznana v profilu Podpeškega kamnoloma, odseva hitre lateralne in vertikalne spremembe, ki so pogoste v podobnih sedimentacijskih okoljih, tj. notranje razčlenjeni laguni.[64] Količina ter raznolikost skeletnih zrn je tu relativno visoka. Emerzijske površine so prisotne skozi celoten del zaporedja v obliki rdečkastih in rumenkastih glinenih zapolnitev ter v lezikah. V več kot 100 m debelem kompozitnem profilu (*sl. 21*), izmerjenem in vzorčenem od najsevernejšega dela hriba Sv. Ane proti jugu do meje s Členom marogastega apnenca, smo določili 10 pojavljajočih se faciesnih tipov (*sl. 22*) ter en faciesni tip (6A), ki je bil zaznan samo v eni plasti. Faciesni tipi lahko lateralno prehajajo v sorodne tipe.

Razlikovanje faciesnih tipov temelji na razlikah v barvi,[65] strukturi in vrsti zrn. Struktura apnencev predstavlja geometrijski in prostorski odnos med zrni in vezivom.[66]

V stratigrafsko najnižjem (starejšem) delu zaporedja (sonde 1, 3, 4 in izdanek v kleti hiše Podpeč 44; *sl. 21*) prevladujejo temni mikritni apnenci (faciesni tip 1B). Plasti so debele od 10 do 120 cm. Najbolj prepoznaven facies tega dela zaporedja je temni mikritni apnenec z odlomki ali celimi lupinami megalodontidnih školjk (faciesni tip 5C). Njihove bele lupine opazno izstopajo iz temnega veziva. V debelino merijo te plasti od 38 do 80 cm. V nadaljevanju zaporedja postanejo pogostejši nekoliko svetlejši ooidni apnenci (faciesni tip 3B), ki se v več plasteh pojavljajo poleg srednje sivih mikritnih apnencev (faciesni tip 1B). Sledi 7,6 m dolg pokrit interval med sondo 1 in površinskimi najsevernejšimi izdanki kamnin. V nadaljevanju zaporedja, ki je razkrito tudi na površini, prevladujejo nekoliko svetlejši različki apnenca. Ooidni apnenec je pogost facies, ki se pojavlja v do 7 m debelih plasteh (faciesni tip

[59] Ogorelec 2009.
[60] Gale, Kelemen 2017, sensu Dozet, Strohmenger 2000.
[61] Buser, Debeljak 1995; Debeljak, Buser 1997.
[62] Ramovš 2000.
[63] Gale 2015.
[64] Gale, Kelemen 2017.
[65] Munsell Color (Firm) 2010.
[66] Embry, Klovan 1971.

3B). Velike litiotidne školjke (faciesni tip 5A) v subvertikalnem položaju se prvič pojavijo v masivni, več metrov debeli plasti z ooidnim vezivom. Ta plast je svetlejše barve kot nekaj primerov faciesa litiotidnega apnenca, ki jih najdemo višje po zaporedju. Plasti in horizonti apnenca z litiotidami so debeli od 60 do 180 cm. V zaporedju, ki je nadalje razgaljeno v modernem kamnolomu, poleg plasti ooidnega apnenca najdemo še več plasti, bogatih z obraščenimi zrni, bioklasti in manjšimi intraklasti (faciesni tip 4A), plasti svetlega in temnega mikritnega apnenca, pa tudi nekaj plasti z megalodontidnimi školjkami. Za zgornji del zaporedja so značilne zelo debele do masivne plasti ooidnega, mikritnega in bioklastičnega apnenca. Zadnji plasti opisanega zaporedja na najbolj južnem delu kamnoloma sledi zaporedje tankoplastnatega temnega mikritnega apnenca, ki že pripada Členu marogastega apnenca. Tega tvorijo ploščaste (zelo tanke) plasti temno temno sivega mikritnega apnenca in temno sivega mikritnega apnenca s krinoidi in/ali ooidi žarkovite zgradbe.

IZDELKI

Litološka sestava izdelkov iz spodnjejurskega in nekaterih drugih apnencev

V zvezi s proizvodnjo podpeškega kamnoloma se je vseskozi domnevalo, da je bila namenjena predvsem oskrbi rimske kolonije Iulia Emona, pri čemer podpeški kamnolom nikakor ni bil edini, ki je zadovoljeval njene potrebe.[67] Karakterizacija 288 izdelkov, odkritih v Ljubljani in v njeni neposredni okolici, hranjenih danes v zbirkah Narodnega muzeja Slovenije (NMS)[68] in Mestnega muzeja v Ljubljani (MGML),[69] ali vzidanih v ljubljanske stavbe[70] oz. postavljenih na prostem,[71] je na velikem vzorcu jasno potrdila več sočasnih virov oz. kamnolomov apnenca.[72] Poleg spodnjejurskega apnenca, vezanega na Podpeč in domnevno Podutik,[73] še litotamnijski apnenec miocenske starosti, običajno povezovan z ležišči v okolici Moravč, zgornjekredni apnenec Lipiške formacije z Nabrežine (Aurisina, Italija)[74] ter spodnjekredni apnenec[75] neznanega izvora (*sl. 23*).

Od 288 analiziranih izdelkov jih je 185[76] (64,2 %) uvrščenih v spodnjejursko Podbukovško formacijo, kar kaže, da je imel v Emoni prav ta apnenec med uporabljenimi kamninami glavno vlogo. Faciesni tipi 3A, 4A, 5A, 5B, 5C in njihovo menjavanje, ki so zastopani v 103 izdelkih (55,7 %), so značilni za Člen litiotidnega apnenca. V teh faciesih so kortoidi, onkoidi, debelolupinaste školjke (posebej megalodontide) in brahiopodi ter nekateri

[67] Glej Djurić, Rižnar 2017.

[68] Šašel Kos 1997; za dostop do spomenikov in dovoljenje za njihovo vzorčenje se zahvaljujemo vodstvu NMS, Janki Istenič in Heleni Bras.

[69] Za vsestransko nesebično pomoč pri analizi spomenikov, ki jih hrani MGLM, se iskreno zahvaljujemo Bernardi Županek.

[70] Šašel Kos 1998; 2018.

[71] Za pomoč in dovoljenje za vzorčenje spomenikov se zahvaljujemo ZVKDS OE Ljubljana in Miji Topličanec.

[72] V precej majhnem deležu je v Emoni prisoten tudi vzhodnoalpski beli marmor kamnolomov Gummern (A) in Pohorje (SLO). V popis je vključen tudi edini znani izdelek iz zgornjekarbonskega peščenjaka z Ljubljanskega gradu, ki je bil uporabljan kot glavni gradbeni kamen v Emoni; Djurić, Rižnar 2017.

[73] Izdelki iz spodnjejurskega apnenca iz kamnoloma Ig/Staje v katalog niso vključeni na podlagi mesta njihovega odkritja ter njihovih formalnih lastnosti in onomastičnih posebnosti.

[74] Krašna 2019.

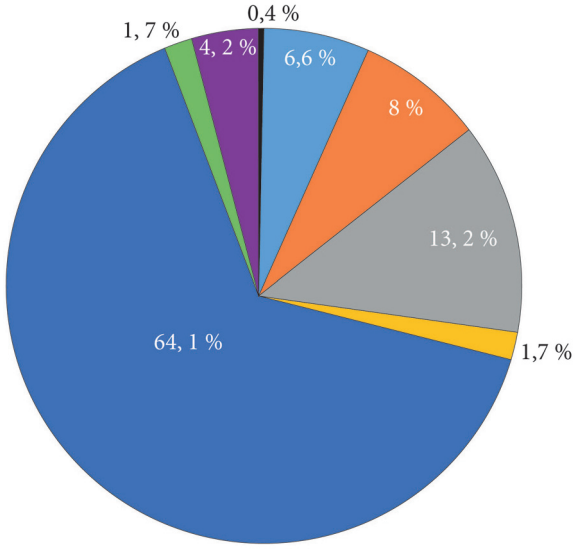
[75] Prvič določen v Vodnik 2016.

[76] MGML inv. št. 3031, 7050, 8711, 8724, 35203, 35204, 35209a, 35209b, 35210, 35211, 35445, 42024, 42248, 47125, 48557, 48560, 48565, 48566, 48572, 48592, 48593, 51180, 51181, 51182, 51185, 51187, 52171, 52830, 52831, 52832, 52833, 57722, 57724, 57725, 57726, 57727, 57728, 57729, 57730, 57731, 57733, 57735, 57736, 59816, 59818, 59824, 60174, 60175, 60176, 60177, 60180, 60182, 60183, 60184, 60189, 60191, 60202, 60203, 60204, 60205, 60207, 60209, 60210a, 60210b, 60213, 60216, 61457, 62390, 61457, 62779, 62786, 63840, 78886, 78887, 79972, 97928; nekateri deli stebrov v MGML, ki so trenutno brez inv. št., imajo našo interno številko EMN 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22; NMS inv. št. L31, L32, L35, L36, L37, L39, L40, L42, L48, L54, L56, L58, L62, L64, L71, L76, L77b, L78, L83, L84, L85, L87, L88, L128, L141, L144, L147, L160, L164, L166, L187, L188, L191, L198, L209, L201, L210, L224, L225, L226, L227, L228, L229, L230/232, L231, L235, L236, L239a, L239b, L250, L252–L272; 3 spomeniki Dolničarjevega lapidarija (Šašel Kos 1998, št. 1, 7, 14); 3 spomeniki v lapidariju Križanke in eden v Gorenjskem muzeju (Šašel Kos 2018, 20–21, 21–23, 25, 28); 6 kosov ob Aškerčevi cesti 1– pokrov in popravilo kloake z emonske ceste E (Plesničar Gec 1999, sl. 38); stela za Antonijo Maksimilo na Ljubljanskem gradu; 4 kosi ploščadi z emonske ceste B (Plesničar Gec 1999, sl. 87) na Turnograjski ulici; dva hišna praga in baza kompozitne are v arheološkem parku Mirje; pravokotni blok in del epistila s foruma (Plesničar Gec 2006, sl. 44) pred gostilno Pod lipco.

Primer artefakta / Example of artefact	Faciesni tip / Facies type	Minim. možna debelina plasti / Minim. possible bed thickness	Položaj v podpeškem kamnolomu / Position within the Podpeč quarry	Delež te skupine / Proportions of this group
MGML 57730 telo stebra / column shaft	**1A** (*sl. / Fig. 29*)	42 cm	■	6,5 %
NMS L209 lorica	**1B** (*sl. / Fig. 29*)	30 cm	□ ■	12,0 %
MGML 52832 pepelnica / ash chest	**2A** (*sl. / Fig. 29*)	30 cm	□ ■	4,3 %
MGML 48592 žara na nogi / urn with base	**2B** (*sl. / Fig. 29*)	18 cm	□ ■	14,1 %
NMS L128 sepulkralna ara / sepulchral altar	**3A** (*sl. / Fig. 29*)	52 cm	□ ■	7,1 %
MGML 35203 lorica	**3B** (*sl. / Fig. 29*)	52 cm	□ ■	7,1 %
NMS L236 pepelnica / ash chest	**4A** (*sl. / Fig. 29*)	36 cm	□ ■	8,7 %
NMS L239 sarkofag / sarcophagus	**5A** (*sl. / Fig. 29*)	74 cm	■	3,8 %
Mirje baza are / altar base	**5B** (*sl. / Fig. 29*)	38 cm	□ ■	3,8 %
MGML 60210 baza stebra / column base	**5C** (*sl. / Fig. 29*)	55 cm	□ ■	19,0 %
MGML 52833 ara / altar	* **1B, 3B, 5B** (*sl. / Fig. 28*)	45 cm	□ ■	2,2 %
NMS L37 pepelnica / ash chest	* **1B, 5B** (*sl. / Fig. 28*)	45 cm	□ ■	7,1 %
NMS L147 arhitrav / architrave	* **1B, 5C** (*sl. / Fig. 28*)	32 cm	□ ■	5,3 %

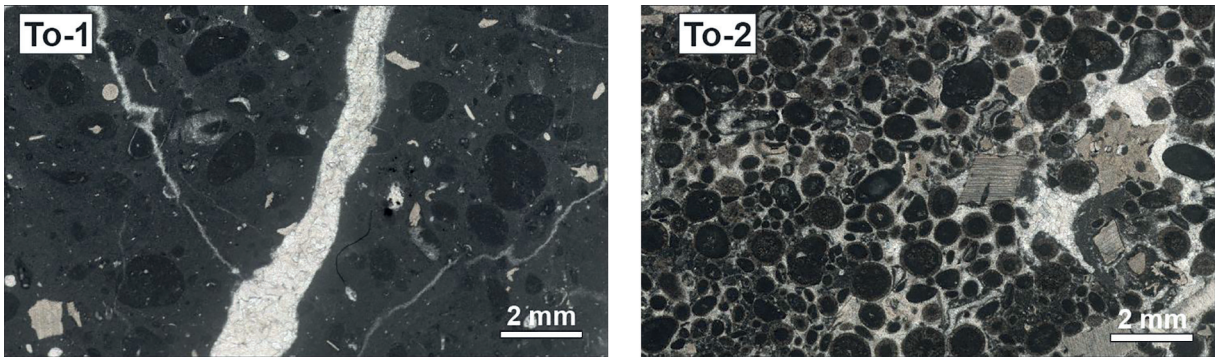
***** = Menjavanje faciesnih tipov / Alternation of facies types
□ = Arheološka sonda / Archeological trench; ■ = Moderni kamnolom / Modern quarry

Tab. 1: Ujemanje v litologiji in debelini plasti med plastmi apnenca Člena litiotidni apnenec v podpeškem kamnolomu in preiskanimi artefakti iz Emone.
Tab. 1: Concordance in lithology and bedding thickness between the limestone beds of the Lithiotid Limestone Member in the Podpeč quarry and studied artefacts from Emona.

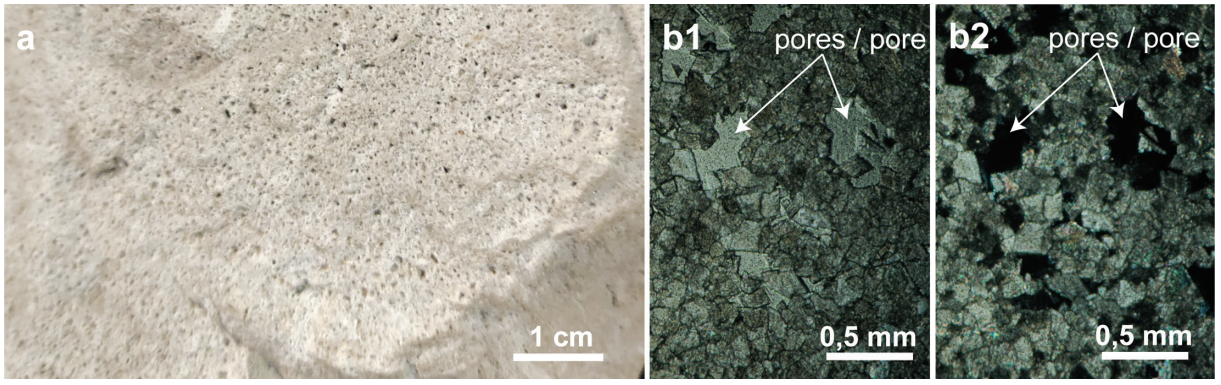


1 – vzhodnoalpski marmor / Eastern Alpine marble;
2 – spodnjekredni apnenec (izvor neznan) / Lower Cretaceous limestone (origin unknown);
3 – zgornjekredni apnenec / Upper Cretaceous limestone (Aurisina / Nabrežina);
4 – kalcitna siga / calcite tufa (Aurisina / Nabrežina);
5 – spodnjejurski apnenec / Lower Jurassic limestone (Podpeč, Podutik?);
6 – srednjejurski dolomit / Middle Jurassic dolomite (Podpeč?);
7 – neogenski litotamnijski apnenec / Neogene Lithotamnian limestone (Moravče);
8 – zgornjekarbonski peščenjak / Upper Carboniferous sandstone (Ljubljana – Grajski grič [Castle Hill]).

Sl. 23: Količine v Emoni uporabljanih kamnin v odstotkih.
Fig. 23: Quantities of stone used in Emona in percentages.



Sl. 24: Zaznani faciesi v izdelkih z območja Emone iz toarcijskega Člena marogasti apnenec. Oznaka To-1 predstavlja facies temno siv apnenec s krinoidi in intraklasti, To-2 pa temno siv apnenec s krinoidi in radialnimi ooidi.
Fig. 24: Recognised facies in artefacts from Emona made from the Spotty Limestone Member. Marker To-1 represents the facies of dark grey limestone with crinoids and intraclasts, and the To-2 represents the dark grey limestone with crinoids and ooids.



Sl. 25: Izdelek iz Emone. Dolomitni makro (a), mikrofacies (b1) [b2: posnetek z vklopljenim analizatorjem.]
Fig. 25: Artefact from Emona. Dolomite macro (a), microfacies (b1) [b2: and photo with the analyser on.]

fosili z ozkim stratigrafskim razponom, kot so foraminifera *Orbitopsella* ali litiotidne školjke. Teh faciesov praviloma ne najdemo v drugih členih Podbukovške formacije. Nasprotno nastopajo faciesni tipi 1A, 1B, 2A, 2B in 3B, ki predstavljajo skupaj 79 izdelkov (42,7 %), tudi v Členu krkinega apnenca in Členu orbitopselnega apnenca. Pričakujemo, da bodo dokončno opredelitev teh izdelkov dali rezultati kemostratigrafskih analiz izotopov ogljika in stroncija, ki so še v teku. Ker obravnavani izdelki (stele, urne) iz definiranih faciesnih tipov kažejo visoko formalno homogenost s kosi, ki so nedvoumno izdelani iz Člena litiotidnega apnenca, trenutno domnevamo, da tudi ti pripadajo temu členu in ne stratigrafsko nižjim delom Podbukovške formacije.

Tabela 1 podaja primere razvrstitve izbranih izdelkov z območja Emone v posamične faciesne tipe Člena litiotidni apnenec. Poleg litologije in barve smo pri določanju možnih izvornih plasti upoštevali tudi dimenzije izdelkov.

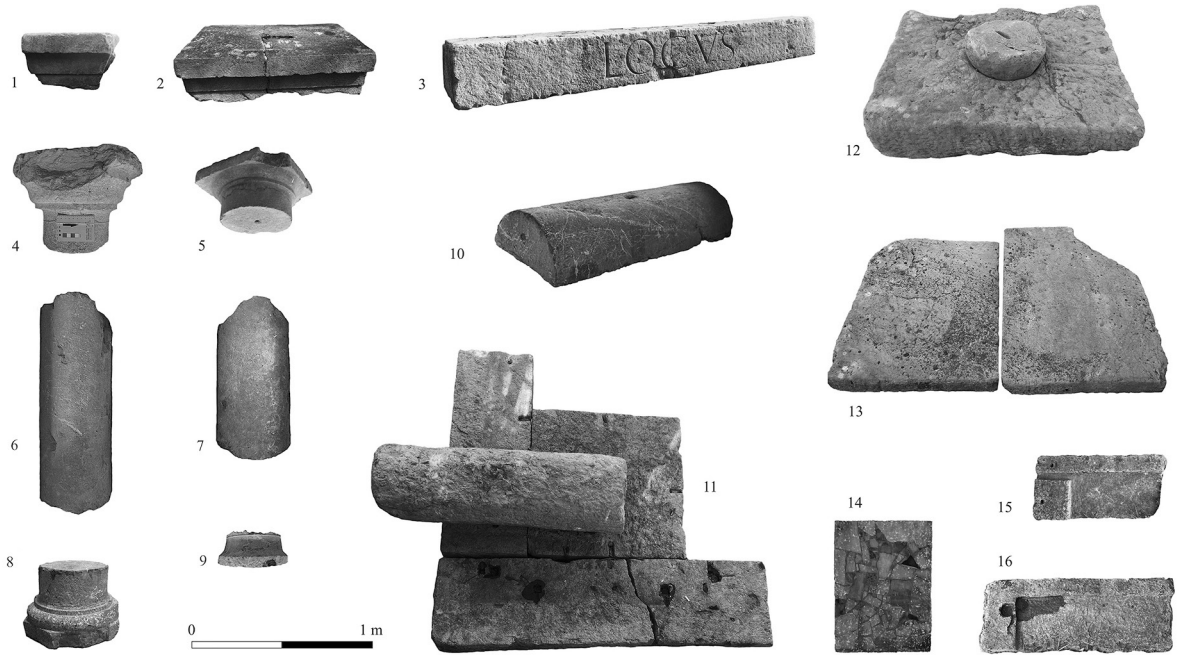
Trije kosi (1,6 %) iz vzorčene skupine so izdelani iz dveh značilnih faciesnih tipov ploščastega apnenca Člena marogastega apnenca.[77] Gre za facies temno siv apnenec s krinoidi in ooidi ter facies temno siv apnenec s krinoidi in intraklasti (*sl. 24*). Na območju Podpeči ta člen nastopa tik nad modernim kamnolomom (glej *sl. 19*).

Pri geološki karakterizaciji je bila prepoznana tudi skupina izdelkov (oltarjev),[78] ki pripadajo istemu faciesnemu tipu, a tega zaradi dolomitizacije prvotne kamnine ni mogoče stratigrafsko natančno opredeliti. Gre za debelozrnate dolomite z luknjičasto strukturo (*sl. 25*). Na posameznih delih izdelkov je ohranjena tudi tekstura ooidnih zrn.

Na podlagi detajlnega geološkega kartiranja širšega območja Podpeči ugotavljamo, da ustrezni

[77] Facies To-1 (MGML inv. št. 61457) – pokrov, facies To-2 (MGML inv. št. 51182, NMS inv. št. L45).

[78] NMS inv. št. L34, NMS inv. št. L60, NMS inv. št. L61, NMS inv. št. L63.



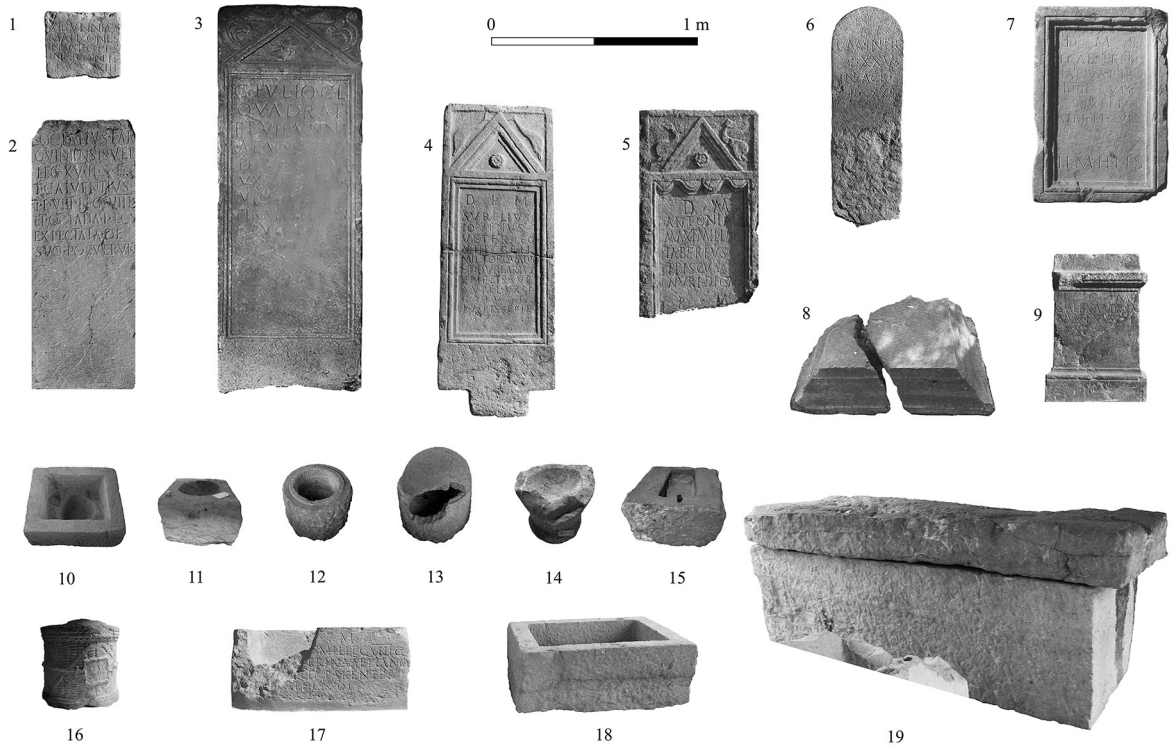
Sl. 26: Izdelki iz Emone, podpeški kamnolom. Enkratna kamnolomska naročila.
Fig. 26: Products from Emona, Podpeč quarry. One-time quarry orders.
1 – del toskanskega arhitrava / part of Tuscan architrave (Ljubljana – Aškerčeva cesta); **2** – del toskanskega arhitrava s foruma / part of Tuscan architrave from the forum (Ljubljana – Gostilna Pod lipco); **3** – arhitrav / architrave (NMS L147); **4** – toskanski kapitel / Tuscan capital (MGML 60205); **5** – toskanski kapitel / Tuscan capital (NMS); **6** – telo stebra / column shaft (MGML 57731); **7** – telo stebra / column shaft (MGML 57728); **8** – toskanska baza stebra / Tuscan column base (MGML 60210); **9** – noga jonskega stebra / foot of the Ionic column shaft (MGML 60175); **10** – lorica (NMS); **11** – plošča in bloki za tlakovanje z emonske ceste B / paving plate and blocks from Emona road B (Ljubljana – Ulica Josipine Turnograjske); **12** – pokrov kloake z emonske ceste E / cloaca cover from Emona Road E (Ljubljana – Aškerčeva cesta); **13** – plošči popravila kloake na emonski cesti E / plate for cloaca repair on Emona Road E (Ljubljana – Aškerčeva cesta); **14** – fragmenti plošč za površine v *opus sectile* / fragments of *opus sectile* plates (Ljubljana –Plečnikov lapidarij na Mirju [Plečnik's lapidary on Mirje]); **15, 16** – prag vhoda / threshold (Ljubljana – arheološki park Mirje).

litološki različek dolomita najdemo v dveh stratigrafskih členih, pri čemer njihovo pojavljanje ni zvezno in se lateralno pogosto hitro zaključi. Tovrstni dolomiti so lokalno prisotni na vzhodnem pobočju hriba Sv. Ana, in sicer na prehodu Člena litiotidni apnenec v Člen marogastega apnenca ter v srednjem in zgornjem delu zaporedja Lazenske formacije. V obeh primerih je izvorna kamnina večinsko sestavljena iz ooidnih apnencev.

Izdelki podpeškega kamnoloma

Podpeška proizvodnja pozna zelo različne izdelke iz masivnega kamna, pri čemer gre v nekaterih primerih tudi za rabo gradbenega kamna (tlakovanje, kamniti bloki in plošče ipd.). Resnični obseg tovrstne rabe v Emoni je težko oceniti, saj sistematičnega dokumentiranja in hranjenja kamnitih blokov in plošč doslej ni bilo. Je pa iz objav izkopavanj, predvsem Walterja Schmida[79] in Ljudmile Plesničar Gec,[80] mogoče sklepati, da je bila raba takih kosov v Emoni dovolj razširjena.[81] To kaže tudi veliko število različnih kosov, ki so poleg arhitekturnih členov hranjeni v depoju MGML in v našem popisu niso v celoti zajeti. Število arhitekturnih delov in delov različnih struktur je treba zato v primerjavi s številom prenosnih monolitnih izdelkov, kakor to izhaja iz našega popisa (46 % proti 54 %), brez dvoma popraviti v korist prve skupine. Celotnega obsega proizvodnje podpeškega kamnoloma seveda ni mogoče zanesljivo ugotoviti, če pa zanjo kljub nekaterim zadržkom uporabimo izračun, narejen za proizvodnjo sarkofagov,[82] po katerem je ohranjeno približno 1,5 odstotka celotne proizvodnje, lahko domnevamo, da je podpeški kamnolom v

[79] Schmid 1913.
[80] Plesničar Gec 1999.
[81] Glej npr. številne pragove vrat v Schmid 1913.
[82] Koch 2015, 154–157.



Sl. 27: Izdelki iz Emone, podpeški kamnolom. Serijski kamnolomski izdelki.
Fig. 27: Products from Emona, Podpeč quarry. Serial quarry products.
1 – nagrobni titulus za Vibunijo Matrono / titulus for Vibunia Matrona (NMS L32); **2** – nagrobna stela za Lucija Oklatija Tarkvinijca / stela for Lucius Oklatius Tarquiniensis (Ljubljana, Dolničarjev lapidarij [Dolničar's lapidary]); **3** – nagrobna stela za Gaja Julija Kvadrata / stela for Gaius Iulius Quadratus (Ljubljana, lapidarij Križanke [Križanke lapidary]); **4** – nagrobna stela za Avrelija Iovina / stela for Aurelius Iovinus (NMS L40); **5** – nagrobna stela za Antonijo Maksimilo / stela for Antonia Maximila (Ljubljana, Ljubljanski grad [Castle]); **6** – mejnik grobne parcele / a boundary stone of a grave plot (NMS L88); **7** – telo kompozitne nagrobne are za Tita Cezernija Ianuarija / shaft of a composite funerary altar for Titus Caesernius Ianuarius (NMS L128); **8** – baza kompozitne are / base of a composite altar (Ljubljana – arheološki park Mirje); **9** – votivna ara za Jupitra / votive altar for Iuppiter (NMS L78); **10** – kvadratna žara s kvadratno odprtino / square urn with a square hole (NMS); **11** – kvadratna žara z okroglo odprtino / square urn with round hole (MGML 60177); **12** – cilindrična žara / cylinder urn (NMS); **13** – cilindrična žara s kupolastim pokrovom / cylinder urn with dome cover (NMS); **14** – situlasta žara na nogi / situla-form urn with base (MGML 48557); **15** – baza za stelo / base of a stele (MGML 62779); **16** – nadzemna pseudožara v obliki pletene košare / above-ground pseudo-urn in the form of a wicker basket (MGML 42024); **17** – nadzemna pepelnica za Elijana / above-ground ash chest for Elianus (NMS L42); **18** – vkopana pepelnica / buried ash chest (NMS); **19** – sarkofag / sarcophagus (NMS).

dobrih treh stoletjih samo za Emono izdelal več kot 11.500 različnih izdelkov.[83]

Izdelke iz podpeškega kamnoloma je za analizo smiselno deliti na različna enkratna naročila: arhitekturne elemente (baze, telesa in kapiteli stebrov, deli entablatur in vencev, *loricae*) in različne dele opreme mesta (tlakovanje, kloake, oprema obzidja) in stavb (vhodni pragovi, stopnice, tlakovanje, *crustae*) na eni strani (*sl. 26*) ter na drugi na serijske izdelke: oltarje, stele, napisne plošče, mejnike, sarkofage, nadzemne in vkopane pepelnice ter nadzemne in vkopane žare (*sl. 27*). V kronološkem smislu so med njimi določljivi predvsem izdelki, ki nosijo različne napise (oltarji, nagrobne stele, napisne plošče), ali pa so določljivi formalno tipološko (nagrobne stele). Z zunanjimi elementi so določljive grobne žare in pepelnice, kadar je njihova vsebina ohranjena in dokumentirana, medtem ko je mogoče različne arhitekturne dele kronološko določiti predvsem na podlagi originalnih kontekstov, ti pa so v Emoni sila redki oz. sila redko ustrezno dokumentirani.[84] Celovita tipološko-kronološka

[83] Pri tem je treba upoštevati, da je bilo recikliranje kamnitih izdelkov v urbanih okoljih predvsem v pozni antiki zelo veliko.

[84] Podatke te vrste si obetamo z najnovejših, še neobjavljenih izkopavanj pod vodstvom MGML.

analiza arhitekturnih elementov iz Emone doslej ni bila opravljena.

V popis zajeti spomeniki so bili izdelani iz spodnjejurskega apnenca različnih faciesnih tipov (plasti) v dokaj neenakih deležih (*sl. 28*). Naša analiza je pokazala, da je bil najpogostejši izbor faciesnega tipa 1B z več kot četrtinskim (26,1 %) deležem, sledijo faciesni tip 5C s skoraj petinskim (19 %), faciesni tip 2B z več kot desetinskim (13 %) in faciesni tip 4A s skoraj desetinskim deležem. Vsi drugi faciesni tipi so v gradivu zastopani s precej manjšimi deleži. Razlike v gradivu zastopanih posameznih faciesnih tipov si je mogoče razlagati na eni strani s stopnjo njihove pojavnosti znotraj kamnoloma, na drugi strani pa tudi kot možno posledico namenskega izbora kamnosekov, povezanega s posebnimi lastnostmi plasti v kamnolomu.

Med analiziranimi spomeniki jih je samo 31 (10,8 %) kronološko določenih, med njimi pa vsaj 18[85] (58 %) izdelanih v 1. stoletju, 9[86] (29%) v 2. stoletju in 4[87] (13%) v 3. stoletju (*sl. 29*).

Ta skupina enaintridesetih spomenikov je bila izdelana iz kamnine, ki jo lahko umestimo v osem od desetih v podpeškem kamnolomu prepoznanih faciesnih tipov (1A in 1B, 2B, 3A in 3B, 5A, 5B in 5C), vendar v neenakih količinah (*sl. 30*). V 1. stoletju je bila za njihovo izdelavo uporabljena kamnina samo petih faciesnih tipov (1B, 2A, 3A, 3B in 5C), v treh primerih[88] med njimi kamnina, ki kaže prehajajoče faciesne tipe (1B/5B, 1B/5C). Ta izbor plasti oz. faciesnih skupin načeloma omogoča določitev najverjetnejšega kraja začetnega izkoriščanja apnenca v Podpeči.

Analiza arhitekturnih delov (vsi deli stebrov, *loricae*), pepelnic in žar, ki jih kronološko sicer ne moremo nedvoumno opredeliti, kaže zanimivo prednostno rabo nekaterih faciesnih tipov (plasti) za posamezne skupine izdelkov (*sl. 31*). Najbolj očitna je prednostna raba faciesnega tipa 5C za izdelavo stebrov, nedvomno iz dekorativnih razlogov,[89] kar posredno dokazuje tudi raba predvsem faciesnih tipov 1B in 3B za izdelavo stebrom podobnih elementov – lorik, med katerimi ne poznamo takih, ki bi bile izdelane iz apnenca faciesnega tipa 5C. Podobno lahko pri žarah, ki so bile izdelane iz plasti skoraj vseh faciesnih tipov, ugotovimo prednostno rabo faciesnih tipov 2B in 4A.

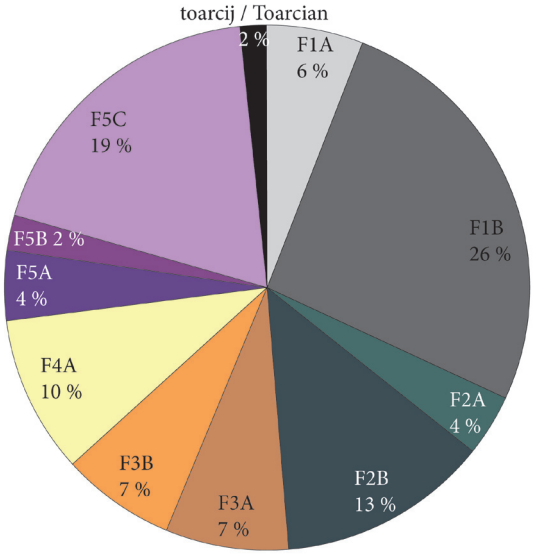
[85] MGML 63840; NMS L32, L35, L36, L37, L40, L48, L54, L84, L87, L88, L164; Dolničarjev lapidarij, Šašel Kos 1998, št. 1, 6, 14; lapidarij Križanke, Šašel Kos 2018, sl. 5, 10, 12.

[86] NMS L31, L56, L58, L78, L128, L144, L160; Gorenjski muzej, Šašel Kos 2018, 21; nagrobna stela za Antonijo Maksimilo, Ljubljanski grad.

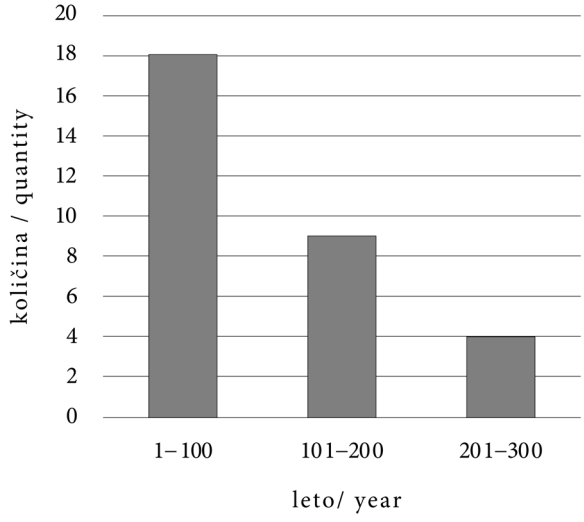
[87] MGML 48560, 52833; NMS L42, L166.

[88] NMS L32, L37, L164.

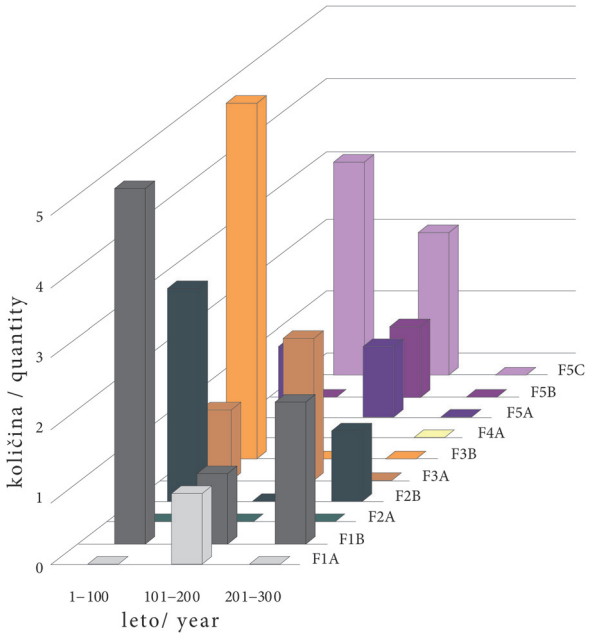
[89] Glej ugotovitve v Djurić, Gale, Miletić 2018.



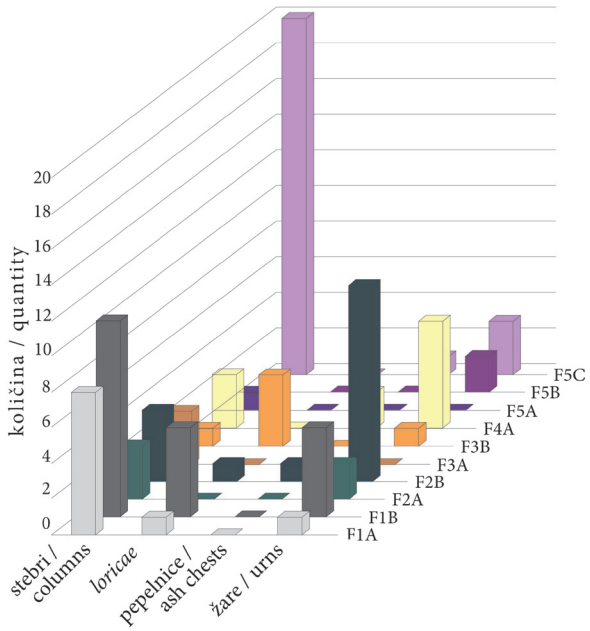
Sl. 28: Zastopanost spodnjejurskih faciesnih skupin (in toarcijskega apnenca) znotraj analizirane skupine spomenikov iz Emone.
Fig. 28: Representation of Lower Jurassic facies types (and Toarcian limestone) within the analysed group of monuments from Emona.



Sl. 29: Količinsko razmerje kronološko določljivih izdelkov iz Emone.
Fig. 29: Quantitative ratio of chronologically identifiable products from Emona.



Sl. 30: Razmerje kronološko določenih spomenikov iz Emone po podpeških faciesnih skupinah.
Fig. 30: Relation of chronologically determined monuments from Emona by Podpeč facies types.



Sl. 31: Količinska razmerja med stebri, lorikami, pepelnicami in žarami iz Emone po faciesnih skupinah.
Fig. 31: Quantitative ratios between columns, *loricae*, ash chests and urns from Emona by facies types.

V formalno tipološkem pogledu je med izdelki mogoče bolje opredeliti samo nagrobne stele in do neke mere žare, deloma pa tudi stebre in dele entablatur. Zgodnje stele, ki jih je ohranjenih največ in so nastajale od avgustejskega obdobja skoraj do konca 1. stoletja (*sl. 32*), imajo forme navezane na proizvodnjo nabrežinskega kamnoloma, ki je s svojimi izdelki v Emoni 1. stoletja sicer močno prisotna. Take so tri stele v obliki preproste pravokotne plošče,[90] ena za veterana 15. legije Lucija Oklatija Tarkvinijca (*L(ucius) Oclatius Tarquiniensis*) (*sl. 32:* 1),[91] druga za Akcepto (*[A]cceptae*) in druge (*sl. 32:* 2) [92] ter tretja za veterana 15. legije Lucija Obulsija (*L(ucius) Obulsius*) (*sl. 32:* 3).[93] V zgodnji proizvodnji nabrežinskega kamnoloma je ta preprosta oblika stel med najpogostejšimi,[94] bi pa v to skupino lahko uvrstili tudi podobno napisno ploščo Vibunije Matrone (… *Vibunniaes Matrones*) (*sl. 32:* 4).[95] Sledijo štiri profilirane stele edikularne zasnove (*profilgerahmte Giebelstele*), kakršne so v nabrežinski proizvodnji običajne.[96] To so stela za Gaja Julija Kvadrata (*C(aio) Iulio … Quadrato*) (*sl. 32:* 5),[97] stela za Gaja Marcija Digna (*C(aius) Marci[us] … Dignus*) (*sl. 32:* 7),[98] stela za vojaka Pudensa (*Pudenti*) (*sl. 32:* 8)[99] in stela za Kvinta Polija Vitala (*Q(uintus) Polius Vitalis*) (*sl. 32:* 6).[100] Okras teh stel je osredotočen na njihov zatrep in zaklinke in obsega motive polpalmet, delfinov, morskega grifona in rozet, tipičnih ali vsaj znanih tudi za nabrežinske izdelke te vrste.[101] Tretjo

[90] Ungegliederte Stele IIIa (Pflug 1989, 34); ungegliederte Schaft Ia (Cigaina 2016, 76).

[91] Šašel Kos 1998, št. 6, 336–337; *lupa* 4202.

[92] Šašel Kos 2018, 20; *lupa* 4196.

[93] MGML 63840; A. Gaspari, *Nova nagrobna stela za veterana 15. Apolonove legije iz Emone* (v pripravi).

[94] Glej npr. Lettich 2003; *lupa* s. v. Aquileia.

[95] NMS L32; Šašel Kos 1997, št. 60, 230–232; *lupa* 1158.

[96] Iz Akvileje so npr. znane stele: Lettich 2003, št. 87, 110, 140.

[97] Šašel Kos 2018, 27; *lupa* 3704.

[98] NMS L84; Šašel Kos 1997, št. 53, 218–220; *lupa* 3705.

[99] NMS L164; Šašel Kos 1997, št. 37, 185–186; *lupa* 4190.

[100] NMS inv. št. L54; Šašel Kos 1997, št. 55, 222–223; *lupa* 3708. Okras v obliki orla v zatrepu stele je sicer običajen okras stel hadrijanskega časa.

[101] Polpalmete se v nabrežinski proizvodnji redko pojavljajo na preprostih stelah (npr.: Lettich 2003, št. 378, Ronchi dei Legionari; *lupa* 14050), pogosteje pa na bogatejše izdelanih arhitekturnih stelah, npr. Museo d'Antichità Trieste, inv. št. 8503 (Vidulli Torlo, Mainardis 2001, 65; *lupa* 16193), NMS L43 (Šašel Kos 1997, št. 51; *lupa* 3702), stela iz Šmarate v gradu Snežnik (Krašna 2019, št. 22; *lupa* 3665). Delfini z rozeto so standardni okras nabrežinskih stel (npr. Lettich 2003, št. 87, 278, 403; *lupa* 14477, 14068, 14418). Morski grifon je v nabrežinski proizvodnji poznan le z dveh arhitekturnih stel (Lettich 2003, št. 118; *lupa* 14018) in (*INSCAQU* 940; *lupa* 19597).

Sl. 32: Stele 1. stoletja iz Emone.
Fig. 32: Stelae of the 1st century from Emona.
1 – stela Lucija Oklatija Tarkvinijca / stele of Lucius Oclatius Tarquiniensis (Ljubljana, Dolničarjev lapidarij [Dolničar's lapidary]); **2** – stela za Akcepto / stele for Accepta (Ljubljana, lapidarij Križanke [Križanke lapidary]); **3** – stela Lucija Obulsija / stele of Lucius Obulsius (MGML 63840); **4** – titulus Vibunije Matrone / titulus of Vibunia Matrona (NMS L32); **5** – stela Gaja Julija Kvadrata / stele of Gaius Iulius Quadratus (lapidarij Križanke); **6** – stela Kvinta Polija Vitala / stele of Quintus Polius Vitalis (NMS L54); **7** – stela Gaja Marcija Digna / stele of Gaius Marcius Dignus (NMS L84); **8** – stela za Pudensa / stele for Pudens (NMS L164); **9** – stela Tita Varija / stele of Titus Varius (NMS L48); **10** – stela Primusa / stele of Primus (lapidarij Križanke).

skupino predstavljata arhitekturni steli razvite oblike z gladkimi polpilastri in korintskimi kapiteli: stela veterana 15. legije Tita Varija (*T(ito?) Vario*) (*sl. 32:* 9)[102] in stela Primusa (*Primus*) (*sl. 32:* 10),[103] obe z okrasom delfinov v zaklinkih in rozet v zatrepih. Take stele so v nabrežinski proizvodnji običajno bogato okrašene, sicer pa značilne in pogoste.[104] Vse opredeljive stele (št. 5, 6, 8, 9, 10, z izjemo št. 3 in 7 na *sliki 32*) imajo hrbtno stran neobdelano.

Na emonskih grobiščih pogoste vkopane žare doslej niso bile deležne posebne obravnave.[105] Skupino vkopanih žar, ki jih lahko pripišemo podpeški proizvodnji, lahko po obliki razdelimo na pravokotne, cilindrične, situlaste in situlaste na nogi. Prve imajo raven pokrov, ki je pogosto

[102] NMS inv. št. L48; Šašel Kos 1997, št. 39; *lupa* 3689.
[103] Šašel Kos 2018, 28; *lupa* 20797.
[104] Lettich 2003, št. 95,116; *lupa* 14020, 14475; – Vidulli Torlo, Mainardis 2001, 65; *lupa* 16193; – Šašel Kos 1997, št. 51; *lupa* 3702.
[105] Obravnavane so bile le v kontekstu objav emonskih grobišč (Petru 1972, posebej str. 14; Plesničar Gec 1972) kot ena od oblik žganega pokopa.

preprosta, neoblikovana kamnita plošča, druge pa raven ali kupolasto izdelan pokrov, kakršnega je mogoče domnevati tudi pri situlasti obliki na nogi.[106] Te žare na nogi so podpeški posnetki iz Nabrežine uvoženih žar, sicer dokaj pogosto odkritih tudi na emonskih nekropolah. Samo žari iz dveh grobov sta zanesljivo datirani z novcema, odkritima v njih: žara iz groba 103 z asom Klavdija I.[107] in situlasta žara iz groba št. 746 z Neronovim asom.[108] Posebna oblika v Emoni odkritih nadzemnih cilindričnih žar (in psevdožar) posnema pleteno cilindrično košaro.[109] Take žare, izdelane iz nabrežinskega apnenca in datirane v 1. stoletje, so znane tudi z akvilejskih nekropol.[110]

V emonski arhitekturi je, sodeč po ohranjenih delih stebrov in delih entablatur, prevladoval toskanski stebrni red. Samo v dveh primerih[111] kažeta nogi ohranjenih stebrov jonsko obliko. Vsi ohranjeni kapiteli in baze stebrov, izdelani v podpeškem apnencu, pripadajo toskanskemu stebrnemu redu, enako pa tudi deli ohranjenih frizov.[112] Višina stebrov, izmerjena na podlagi njihovih premerov,[113] znaša od 2,4 do 3 m. Toskanski stebrni red je v *regio X Venetia et Histria* sicer dokaj razširjen med sredino 1. st. pred n. št. in sredino 1. st. n. št.[114]

ZAKLJUČEK

Na osnovno vprašanje, ali lahko v Podpeči z gotovostjo govorimo o rimskem kamnolomu, je bilo z odkritjem rimskih ostalin v sondi 4 odgovorjeno pritrdilno. Dokaz o rimskem kamnolomu na tem mestu niso toliko odkriti ostanki rimske stavbe, ki bi bila lahko, sodeč po plasti mivke na talni površini, tudi del skladišča za keramične izdelke (amfore?), kolikor so dokaz debela nasutja kamnolomskega odpadnega drobirja (*Halde*) ob njej in terasasto oblikovana kamninska osnova. Glede obsega rimskega kamnoloma se lahko trenutno opremo samo na posredne dokaze. Eni izhajajo iz specifične umestitve prvih stavb v Podpeči v severozahodno pobočje hriba Sv. Ana, to je v prostor, ki je nastal z odstranitvijo kamenega materiala, kakor to situacijo kaže Jožefinski vojaški zemljevid, nastal v letih od 1763 do 1787.

Drugi posredni dokazi izhajajo iz analize mikrofaciesov apnenca v Podpeči in njihovega koreliranja z enakimi analizami rimskodobnih izdelkov, odkritih v Ljubljani. V Podpeči dokumentirani mikrofaciesi spodnjejurskega apnenca in nanje vezno nalegajoči dolomit srednjejurske Lazenske formacije se vsi pojavljajo v izdelkih iz Emone. V stratigrafskem sosledju plasti v Podpeči (glej *sl. 21*) se v izdelkih ugotovljeni različki, ki pripadajo Členu litiotidnega apnenca, koncentrirajo na dveh območjih. Prvo tako območje sodi v stratigrafsko najstarejši del zaporedja v severni del kamnoloma v Podpeči.[115] Tam faciesni različki nastopajo v plasteh debeline, ki je primerljiva s končno velikostjo izdelkov. Drugo tako območje je mogoče ugotoviti v srednjem delu zaporedja,[116] ki je bil popisan tako na vzhodnem kot tudi na zahodnem delu modernega kamnoloma. Ker je bilo vzhodno pobočje v času rimske ekstrakcije umaknjeno v pobočje hriba Sv. Ane in kot tako razmeroma nedostopno za kamnolomsko dejavnost, je bilo drugo primerno območje za ekstrakcijo kamna na območju parc. št. 937, 960, 961 (kmetije št. 6–8; *sl. 2*). V tem delu se plasti apnenca pojavljajo v zelo debelih do masivnih plasteh.

Na večjo verjetnost zgodnjega obstoja rimskega kamnoloma v severnem delu kamnoloma in ne v njegovem srednjem delu kaže tudi frekventnost pojavljanja apnenca faciesnih tipov 1B in 5C znotraj analizirane skupine izdelkov: faciesna tipa 1B in 5C, ki sta pogosta v severnem delu profila, prevladujeta tudi med preučenimi izdelki. Dodatno nam začetni prostor rimskega ekstrahiranja omogočajo ugotoviti najzgodnejši znani izdelki iz Emone. Večina zgodnjih spomenikov ima hrbtno stran neobdelano, tako da je ujemanje minimalne debeline plasti v spomenikih primerljivo z debelino plasti v severnem delu zaporedja Člena litiotidni apnenec, medtem ko so plasti ustreznih faciesov v srednjem delu kamnoloma večinoma predebele. S tem lahko definiramo tisti del zaporedja Člena

[106] Glej npr. nabrežinsko žaro na nogi (Giovannini 2015, Fig. 12).

[107] Petru 1972, 28; *RIC* 66 E.

[108] Plesničar Gec 1972, 253; *RIC* 319.

[109] MGML 42024; Plesničar 1977; NMS L59, L76; Bertoncelj Kučar 1985, 256–257; Šašel Kos 1997, 483; ena žara je izdelana iz neogenskega litotamnijskega apnenca, druga iz podpeškega apnenca.

[110] Scrinari 1972, 105–106; Buora 1982.

[111] MGML 52830, 60175.

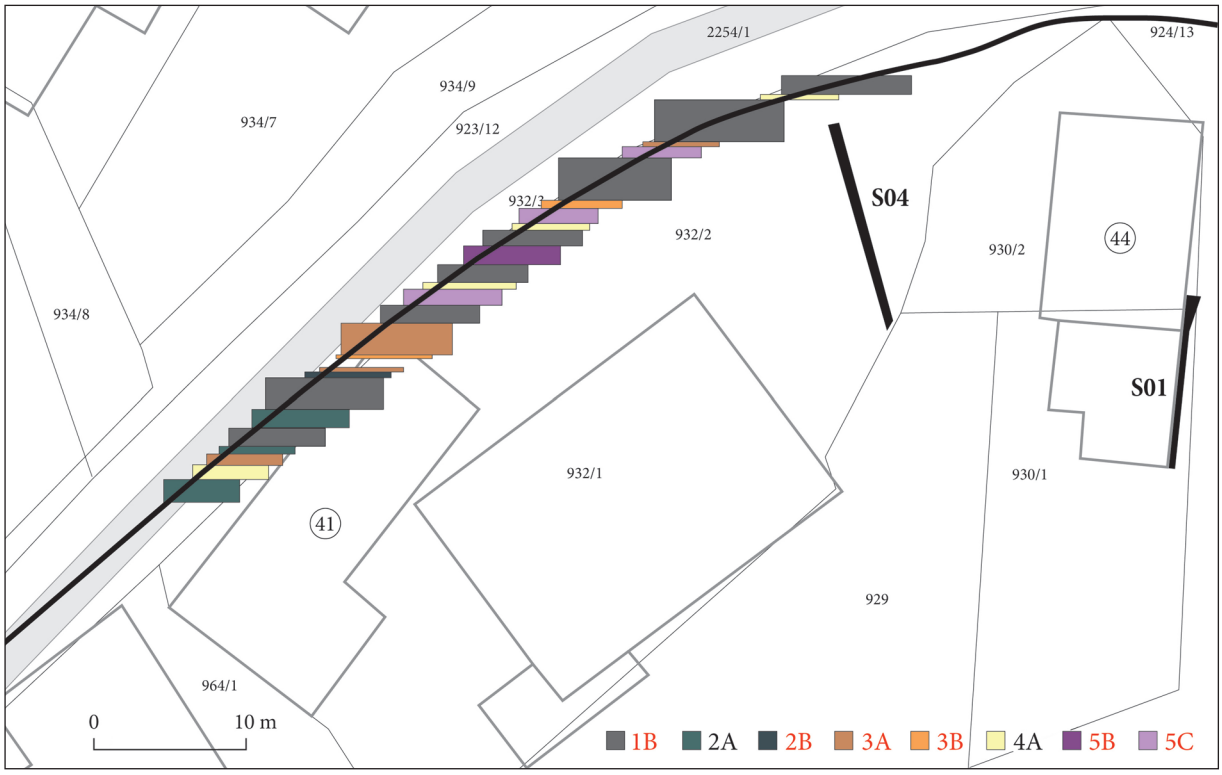
[112] Deli entablature kolonade tretje gradbene faze emonskega foruma po Plesničar Gec 2006, 53, sl. 42b. Odkriti del stoji danes pred vhodom v gostilno Pod lipco.

[113] Proporci toskanskega stebra so: višina baze ½ ϕ, višina telesa 6 ϕ, višina kapitela ½ ϕ.

[114] Cavalieri Manasse 1978, 44; Sacchi 2017.

[115] Faciesi ugotovljeni v sondah 1, 3 in 4.

[116] Na sliki 4 nad profilom objavljenim v: Gale 2015.



Sl. 33: Najverjetnejše območje začetka rimskega pridobivanja kamna na območju Podpeči. Na rekonstruirani rob pobočja je projicirano sosledje faciesnih tipov (1B–5C) ugotovljenih v sondah 1 in 4. Rdeče številke označujejo faciesne skupine določene v najzgodnejših izdelkih iz Emone.
Fig. 33: The most probable location of the beginning of Roman stone extraction in the area of Podpeč. A sequence of facies types (1B–5C) found in Trenches 1 and 4 is projected on the reconstructed edge of the slope. Facies types identified in the earliest Emona products are marked in red.
(Osnova / Map: Land Cadastre; © Geodetska uprava RS)

litiotidnega apnenca v kamnolomu Podpeč, ki je najprimernejši za začetek izkoriščanja kamna na tem območju. Ustrezno območje ustreza najstarejšemu delu zaporedja in ga v prostorskem smislu lahko umestimo na severni severozahodni rob hriba Sv. Ana (*sl. 33*), na območje parc. št. 932 (kmetija št. 3, *sl. 2*; Trček in *sl. 33*).

Upravičeno pa je mogoče pričakovati, da se je pridobivanje kamnitih blokov skozi čas nadaljevalo na več mestih, morda celo kontinuirano po celotnem robu pobočja proti jugozahodu, nekako do točke, ki jo na Jožefinskem vojaškem zemljevidu označuje najzahodnejša kmetija naselja Podpeč. To hipotezo potrjuje tudi karakterizacija posameznih izdelkov, ki so izdelani iz faciesnih tipov 1A in 5A. Ustrezni faciesni različki se pojavijo šele v srednjem delu profila, dobrih 25 m višje od zaporedja, popisanega v sondah. Poleg izdelkov iz Člena litiotidnega apnenca so prisotni tudi izdelki iz toarcijskega Člena marogastega apnenca ter iz dolomitiziranih apnencev in dolomitov, pripadajočih srednjejurski Lazenski formaciji.

V zvezi z izdelki podpeškega kamnoloma je mogoče ugotoviti nekaj pomembnih dejstev. Najprej to, da je kamnolom zadovoljeval vse specifične potrebe Emone po izdelkih iz masivnega kamna, samo deloma pa tudi njene potrebe po gradbenem kamnu. Potrebe in možnosti mesta oz. njegovih prebivalcev po izdelkih iz kamna so skozi stoletja nedvomno precej nihale, kar je bilo neposredno povezano z njihovo vsakokratno kupno močjo.[117] Največje potrebe in s tem največjo proizvodnjo kamnoloma lahko upravičeno pričakujemo ob ustanovitvi mesta in še nekaj časa po njej, kar potrjujejo tudi kronološko določljivi izdelki. Prav zgodnji podpeški izdelki pa hkrati kažejo tako izrazite sorodnosti z izdelki nabrežinskega kamnoloma, ki so v 1. stoletju v Emoni sicer močno prisotni, da lahko z njimi utemeljimo hipotezo o prihodu kamnosekov, ki so po ustanovitvi kolonije začeli delovati v Podpeči, prav z Nabrežine.

[117] Primerjaj podatke o novčnem obtoku v Emoni: Kos 1986; 2006.

Okrajšave / Abbreviations

INSCAQU = G. Brusin, *Incriptiones Aquileiae,* Udine 1991–1993.

RIC = Roman Imperial Coinage.

lupa = *UBI ERAT LUPA* – Bilddatenbank zu antiken Steindenkmälern [http://www.lupa.at] (last checked 2022-01-20].

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Limestone quarry at Podpeč near Ljubljana (Slovenia) and its products

Translation

The Roman quarry in Podpeč near Ljubljana has been hypothesised in the archaeological literature at least since Alfons Müllner.[1] Scholars later assumed that the evidence for its existence was destroyed by post-mediaeval and modern quarrying. Until recently,[2] the presumption of the presence of the Roman quarry in Podpeč was based solely on a macroscopic resemblance between the Lower Jurassic black-grey limestone, which outcrops in Podpeč, and the associated Roman monuments, discovered mainly in Emona (mod. Ljubljana, Slovenia). Microscopic analysis of the Podpeč limestone from the quarry and the objects necessary for the unambiguous determination of the provenance have rarely been carried out.[3] Since it is impossible to distinguish some varieties of limestone from stratigraphically slightly older limestone produced in other postulated Roman quarries at the macroscopic level, the microscopic description of the rock is even more critical.[4] In this paper, we would like to present the results of a lithological characterisation of limestone variants (facies types) within the Lithiotid Limestone Member in the area of the Podpeč quarry and the results of our lithological analyses of the stone monuments discovered in Ljubljana. The precise determination of facies types in the quarry gives a solid basis for accurate formal and historical investigations of Podpeč quarry production. We also publish the first archaeological trench excavation results inside the quarry, confirming the Roman extraction activities at the site and the topographic conclusions based on the historical analysis of the cartographic and cadastral sources related to the quarry.

HISTORICAL TOPOGRAPHY OF THE QUARRY AND THE PODPEČ SETTLEMENT

The settlement of Podpeč in the present-day municipality of Brezovica near Ljubljana lies at the hill of Sv. Ana northern foot where the Ljubljanica River runs closest to the mountainous southern edge of the Ljubljansko barje (Ljubljana Moors). The geographic name Podpeč is of Slavic (Slovene) origin, formed from the name of the distinctive characteristic of the site (peč-ina = rock, cave)[5] and the preposition pod-sub (pod-peč).[6] This characteristic of the location, which gave the place its name, is mentioned in Latin as Rupes[7] by a medieval document from 1265,[8] which defines the boundaries of the territory (*termini possessiones*) of the Bistra Carthusian monastery.[9] Later medieval documents cite the German version of the name Vnderm Stain for the same place in several forms.[10]

We should understand the topographic feature that determined the local name as a rock face, which is most likely not the result of geological processes, as there are almost no natural rock faces at the entire transition from the Krim hills to the southern edge of the Ljubljana Moors. Therefore, the rock face must be a trace of human intervention in the landscape, as a trace of intensive stone extraction, which is chronologically pre-medieval. According to the cultures that intensively used stone to construct and manufacture different objects before the Middle Ages, the extraction of stone in Podpeč can be reasonably linked only to Roman culture.

One can only assume the beginning of the post-Roman exploitation of stone in the absence of direct sources. The first buildings that could use blocks carved there, as well as recycled Roman products (stelae, altars) for their construction and equipment, are nearby castles, churches and monasteries of the 12th and 13th centuries: the tower castle Žabji grad of one of the Spanheim

[1] Müllner 1879, 18.

[2] Djurić et al. 2018b.

[3] For the pilot project, see Djurić, Gale, Miletić 2018.

[4] Ramovš 1990.

[5] See Snoj 2009, *s.v.* Pečina.

[6] See Snoj 2010, 42–43.

[7] … a rupe quesita est super aquam que descendit in Leybacum. Que rupis est quasi via media a Leybaco in Wreuncz …; Mlinarič 2001, 37 translates as ... at the rock above the water…

[8] Kosi et al. 2016, 749; for the full text see Chmel 1849, 67–68.

[9] Mlinarič 1996, 44.

[10] Vnder dem Stain, Vnderem Stain, Vnder dem Stain, Vnderm Stain; see Kosi et al. 2016, 749. Stein is also the German name of the settlement Kamnik pod Krimom.

ministeriales,[11] the Romanesque church of Sv. Lovrenc above Jezero[12] and the Bistra Carthusian monastery,[13] founded in 1255 to 1260.[14] No data for medieval (and modern) activity in the Podpeč quarry are known.[15] It is important to note that, based on a document from 1265, the entire quarry lay within the boundaries of the Bistra territory on its eastern border, which determined the perimeter of the quarry in the east. At this point, the border between the cadastral municipalities of Preserje and Jezero runs. From the early 19th century, the Franciscan cadastre shows this boundary running straight and centrally in an almost north-south direction on Sv. Ana Hill and probably reflects much older ownership relations.[16] In the area of Podpeč, the cadastral boundary shows a departure from an utterly straight course. It explicitly includes the quarry in the cadastral municipality Preserje, while the area of the church of St. Ana, belonging to the Ig lordship, is included with a similar deviation in the cadastral municipality Jezero.

In many ways, the present-day topographic situation of the Podpeč quarry hides its early condition. According to cartographic sources, sometime before 1763–1787, when the Josephine military map[17] was made, the northernmost part of the old quarry was divided into two farms (*Fig. 1*). According to the Franciscan cadastre from 1823 (c.m. Presser), the owners were Jože Artač[18] and Gregor Turk.[19] In the continuation towards the southwest, the settlement of Podpeč in the period before 1763–1787 already included four more farms, whose owners were (in 1823): Jože Vodoničar,[20] Tomaž Šenk,[21] Miha Svete[22] and Lovrenc Makovc.[23] By 1823, a small farm owned by Jože Svete[24] was established in the area between the Artač and Turk farms and the Lovrenc Suhadovnik farm[25] between the Svete Miha and Makovc farms.

This parcel division of the quarry area has been preserved to this day. Various outbuildings have been demolished and built in the quarry over time,[26] while most of the old residential buildings have remained almost unchanged to this day. All farms except one had their quarry (*cava di pietra*)[27] on their backside plots and stayed in the area of a much older quarry.[28] It is obvious, therefore, that the first military map records the actual extent and position of the old quarry, which housed the six farms that made up the Podpeč settlement, which had grown significantly by 1823, including two more farms within the old quarry (*Figs. 1–3*).

The spatial distribution of the buildings of the three northeastern farms, especially those standing north-south (Artač, Svete J.) perpendicular to the slope of the hill, clearly shows the extent of excavation in the old quarry at the time of their construction. These two ground-floor residential buildings were built on the terraces of an old quarry[29] that followed the direction of the geological strata running east-west. They were built using the lower terrace for their cellars, which occupied only the northern part of the floor plans

[11] Nadbath, Rutar 2008; 2012. Two inscription stones were found here: Müllner 1879, 111.

[12] Zadnikar 1982, 537.

[13] Lat. vallis iocosa, nem. Freudenthal. On Roman stone monuments in the monastery, see Müllner 1879, 285–286; Šašel 1960–1961, 188–190.

[14] Marolt 1929; Mlinarič 2001.

[15] Jože Mlinarič (2001, 436) mentions that '/…/ Bistra (was) getting stone from a quarry near Podpeč. The serfs from the local settlements (Kamnik, Prevalje, Goričica) were obliged to transport the processed stone blocks to the water. The serfs from the territory of Pako transported them by water to the Carthusian monastery. /…/', which may reflect, but does not explicitly confirm, the ownership of the Carthusian monastery over the quarry.

[16] In 1725, the Bistra Carthusian Monastery bought the Preserje County Principality with the villages of Zg. and Sp. Brezovica and Podpeč; Ogrin 1964, 165.

[17] Rajšp, Ficko 1996, sections 189, 190.

[18] Artazh Giuseppe, Podpeč 16 /today 46/, house plot nos. 165 and 167, quarry plot nos. 925, 926, 927.

[19] Turch Giorgio, Podpeč 15 /today 41/, house plot nos. 161 and 163, quarry plot no. 929.

[20] Votonizhar/Uottonizhar/Ottonitscher Giuseppe, Podpeč 14 /today 40/, house plot nos. 157 and 159, without quarry.

[21] Schenk Thommaso, Podpeč 13 /today 38/, house plot no. 158, quarry plot no. 963.

[22] Suete Michele, Podpeč 12 /today 35/, house plot no. 154, quarry plot no. 962.

[23] Makauz Lorenzo, Podpeč 11 /today 34/, house plot no. 151, quarry plot no. 960.

[24] Suete Giuseppe, Podpeč št. 24 /today 44/, house plot no. 164, quarry plot no. 930. The farm was probably created by buying plots of Turk farm.

[25] Suhadounig Lorenzo, Podpeč 22 /today 36/, house plot no. 152, quarry plot no. 961.

[26] Outbuilding plot no. 166 was demolished after the WW II, residential building with plot no. 165 but much earlier. Both buildings belonged to the Artač farm.

[27] For the use of the plots, see *Protocoll 1824*. The Artač farm had two plots (925, 927) registered as ghiaja = gravel.

[28] In this area, Ramovš 2000, 16, which is otherwise somewhat unreliable in terms of historical data, assumes the existence of a Roman quarry 'behind Prebil's house, house number 10', known as Knezov pruh.

[29] In the basement of the house Podpeč 44 (Svete, today Vehar), the old terraces of the quarry are still visible.

of the buildings. The residential building of the Turk farm[30] used the same terraced terrain but entirely on the western edge of the northern part of the quarry. Other farms along the road to the southwest probably took advantage of the existing smaller and shallower quarries on this part of the slope for their buildings.

East of the old quarry area, beyond the cadastral boundary of Preserje, in the cadastral municipality Jezero (Seedorf), on plot no. 382 a large quarry owned by the settlement (Ortschaft) Podpeč developed.[31] In 1886, the *Krainische Baugesellschaft*[32] from Ljubljana bought this quarry, active at the construction of the Southern Railway (Südbahn).[33] Shortly afterwards, the *Baugesellschaft* also purchased the neighbouring quarry and the house of Giovanni Comolli,[34] previously owned by Jože Artač, and a large modern quarry then began to develop.[35] Between 1896 and 1898, the new owners cut a large terrace[36] into the stone layers just above the nearby road and another one above it. They set up a small rail to transport material to the loading area along Podpeški potok creek and to deposit rubble material in the nearby marsh area (*Fig. 5*).[37] Terracing and construction of new buildings completely removed the remains of the old quarry in this part.

After WW II, the quarry was nationalised. In 1952, it became the property of the company Marmor, from Ljubljana, which in 1977 was merged with the company Mineral, also from Ljubljana. The modern quarry spread to the south, then partly to the east, and on the west side south of the private plots of the Svete (today Podpeč 44) and Turk (today Podpeč 41) (*Fig. 4*) farms with supposedly well-preserved remains of an ancient quarry.

FIELD RESEARCH

Ground-penetrating radar (GPR) and electrical resistivity tomography (ERT) survey in 2016

Prior to the excavations, a geophysical survey with ground-penetrating radar (GPR) and electrical resistivity tomography (ERT) was performed in the planned area (*Fig. 4*).[38]

To obtain the dielectric permittivity and subsurface resistivity distribution, which would indicate the possible existing signs of limestone extraction, GPR and ERT profiles were located on the edge of the artificial terrace in the north-south direction (*Fig. 5:* A). GPR measurements were performed in parallel 0.5 m distant profiles with a 270 MHz antenna, which provides adequate depth range at sufficient resolution to identify altered limestone morphology due to limestone blocks extraction. For 2D views of GPR profiles (*Fig. 5:* B2, B3), standard processing procedures[39] with ReflexW software[40] were used, 3D displays of GPR reflections were made with the GPR-SLICE software (*Fig. 5:* D).[41] ERT measurements were made with 0.5 m electrode spacing, resulting in 23.5 m of measuring distance of the profile and depth reach of ~ 5 m. Dipole-dipole (DD), Wenner-Schlumberger (WS) and Wenner-alpha (WA) electrode arrangements were used, with their specific sensitivities.[42] However, it turned out that the DD arrangement collected too much environmental noise, which is not surprising in the urban environment; therefore, the WA, which is known for being the least noise-sensitive among the three, is further discussed (*Fig. 5:* B1, B3). The inversion procedure was undertaken using the ZondRes2D inversion program[43] with the focusing inversion algorithm.[44]

[30] Podpeč 41, today Trček.

[31] In size 1 Joch 1457 Klafter (10,989.92 m^2); *Protocoll 1825*. For the functioning of the quarry, see Djurić et al. 2018a.

[32] The construction company was called Kranjska stavbna družba in Slovenian; founded in 1873.

[33] Denkschrift 1898, 7.

[34] Today, the headquarters of the modern quarry, Podpeč 46.

[35] In 1823, plot no. 924 (Presser), where the central part of the modern Podpeč quarry lies, was owned by Jože Artač. Part of it later belonged to the 'Knezov pruh' (plot no. 924/2 and plot no. 984/2), which the Krainischen Baugesellschaft purchased after Ramovš 2000. Jože Artač's residential building became the administrative seat of the quarry, Podpeč 46.

[36] The house Podpeč 45 stands on it.

[37] Denkschrift 1898, 79–80. See attached overview plan. On the extensive upper terrace, today stands a large production hall, where until 2020, there was a sawmill for natural stone.

[38] Research of the Department of Archeology, Faculty of Arts, University of Ljubljana in 2016, led by Branko Mušič.

[39] Jol 2009.

[40] Sandmeier 2011.

[41] Goodman 2015.

[42] Dahlin, Zhou 2004.

[43] Zond geophysical software 2016. *ZONDRES2D – Program for two-dimensional interpretation of data obrained by resistivity and induced polarization methods*.

[44] Portniaguine, Zhdanov 1999.

Results

The results of ERT and GPR profiles show very similar subsurface structures (*Fig. 5:* B), where high resistivity values observed on the ERT model correspond to strong GPR signals, while low resistivity areas overlay with weak-to-absent GPR signals. High resistivity values together with strong GPR signals can be attributed to limestone depression at the southern half of ERT profile (*Fig. 7:* B1), and most probably levelling fill of coarse-grained material of high resistivity together with strong GPR signals along limestone extraction terrace might be indicators of the past quarrying at the northern part of ERT/GPR profile (*Fig. 5:* B2). Areas of low resistivity with weak or absent GPR signals could be indicators of fine-grained natural fills of abysses (*Fig. 5:* B4) in limestone (*Fig. 5:* B3).

Excavation in 2016 and 2017

Presently, the entire area of Roman stone extraction in Podpeč lies under inhabited areas or cultivated areas and buildings. Therefore, there is no longer direct access to the limestone layers in the northern part of the quarry, while the layers to the southwest are visible in the walls on the courtyard sides of the farms. The only exception in the northern part of the quarry is terraced bedrock in the small cellar of the house Podpeč no. 44 (Vehar). To gain insight into the covered beds of limestone, we excavated four trenches.[45] The first three were excavated in 2016 at the first and second terraces of the modern Mineral quarry between the houses Podpeč 44 and Podpeč 46.[46] Due to this area's existing infrastructure, it was impossible to obtain a continuous stratigraphic sequence, so we excavated Trench 4 in the yard of the Turk farm (Podpeč 41) in 2017 (*Fig. 6*).[47]

Trench 1

The 0.8 m wide and 12.3 m long trench was excavated from the bedrock on which the wall of the Podpeč 44 house in the north was built toward south (*Figs. 8; 9*). Above the unevenly broken bedrock, the earth contained the first backfill and rough levelling of spoil mixed with brown earth.[48] A rough-hewn slab (a core made of decorative lithiotid limestone) was discovered in it (*Fig. 7*).[49] Some later strata were laid over this layer.

The levelling of the terrain is not determined chronologically. Nevertheless, we can conclude from the documents that this happened at the latest when the quarry was being arranged at the end of the 19th century when railway tracks were set up to transport stone blocks to the river loading area.[50] Rock samples D1–D21 were taken from the trench.

Trench 3

A 0.8 m wide and 14 m long trench (oriented N–S) was excavated on the lowest terrace of the quarry in the yard west of the Podpeč 46 house (*Fig. 13*). In its southern part, the bedrock was roughly levelled just below the walking surface. The holes were filled with brownish-red earth mixed with spoil. Rare fragments of modern glazed pottery and some iron objects were discovered in it. The middle part of the trench was not deepened due to the infrastructure, and the excavation did not reach the bedrock.

Further north, the trench was extended (*Fig. 10*). At this point, at a depth of about 1 m, we discovered a larger karst sink (locally called 'vodna'), filled with a few larger stone slabs of local limestone, reaching the walking surface. Between the slabs was also a large, rough-hewn guard stone (*Fig. 11*), made of dolomite. From the northern edge of the sink, the bedrock falls rapidly, and thick layers of spoil were laid on it in several layers (*Fig. 12*). A silver Austro-Hungarian coin minted in 1849 was discovered in this spoil.[51] Layers of spoil form the northern edge of the terrace all the way to

[45] Research of the Department of Archeology, Faculty of Arts, University of Ljubljana in 2016 and 2017, led by Bojan Djurić. Trench 2 was abandoned prematurely due to the infrastructure running there.

[46] Students of the Department of Archeology at the Faculty of Arts, University of Ljubljana participated in the excavations: Matic Hudovernik, Gregor Kočar, Danica Mitrova, Špela Okršlar, Jon Pollak and Denis Rondič.

[47] The excavations involved: dr. Edisa Lozić, Nuša Kovačič, Špela Okršlar and Gašper Petkošek.

[48] A few fragments of modern glazed pottery, some animal bones, two lead tubes and part of a machine made in the USA were discovered in it.

[49] Dimensions: 22 × 26 × 10 cm.

[50] Denkschrift 1898, 79–80. See attached overview plan.

[51] Austrian Empire, Franz Joseph (1848–1916), silver, 6 Kreuzer, 1849, Vienna Mint, Krause 2200. Definition Peter Kos (NMS).

the local road. It was confirmed in 2012 with the construction of new sewage infrastructure for the entire settlement.[52] The terrace was built during the quarrying at the end of the 19th century, which would be confirmed by the lost coin at the time. Rock samples E1–E18 were taken in the trench (see *Fig. 13*).

Trench 4

A trench 0.9 m wide and 16.20 m long (oriented N–S, with a slight deviation towards W) was excavated on plot no. 932, c.m. Preserje (*Fig. 16*). The bedrock appears on the walking surface in the southern part of the trench (*Fig. 14*).

Trench 4 showed a stepped shaped production surface of a Roman quarry, formed by breaking blocks along the bedding planes between the subvertical layers of rock (levering). Possible wedge pockets used for horizontal block-breaking were not identified in the explored part of the quarry. On the lowest discovered terrace, we found a part of the wall (Wall 2, height up to 0.7 m; preserved length approx. 4.5 m, heading north beyond the probe) of a building, built with lime mortar with a pseudo-isodomic technique with rectangular limestone blocks of 20 to 40 cm in size (*Fig. 15*). The wall was plastered with lime mortar. The thickness of the wall running in the north-south direction could not be measured due to its position in the trench wall and the extremely unstable layer above it. Traces of the transverse wall preserved in the southern corner were 0.6 m thick. The exposed part of the room had a floor surface covered with a layer of sand, which in the southern part of the room was partly on bedrock and partly on a quarry spoil, and in the northern part on larger crushed stones that filled production unevenness. A buried karst sink was discovered in the extreme southern part of the trench. The height difference between the highest point of the bedrock on the south and the lowest point on the north is 2.4 m. Rock samples F1–F21 were taken in the probe (see *Fig. 16*). The discovered part of the Roman quarry and the ruins of the building within it were filled with quarry spoil SE 9 (*Halde*; rare stones up to 20–25 cm in size, mostly between 5–10 cm and smaller) mixed with reddish-brown loamy soil. Fragments of Roman amphorae were found on the surface of the Roman spoil and at the top of the preserved wall (PN 1–5, *Figs. 17; 18*).

On the ruins of the building and on the layers of spoil, with a few fragments of Roman pottery on the surface and in its upper part, dark brown humus SE 7 was formed, marking the period of the suspension of quarry activities. The first new activity is marked by the chronologically indeterminable Pit SE 11 in the Roman spoil heap that destroyed part of the Roman building. Subsequently, the pit was filled with a thick layer of spoil SE 10, undoubtedly marking the restored quarry activity. Its intensive continuation, which cannot be determined chronologically, is shown by a thick layer of spoil SE 3 over the entire surface of the excavated area. After the abandonment of this activity, a garden with earth that was probably brought in was created in the northern part of the area. An access road was constructed in the southern part with a bedrock on the surface (SE 1).

The chronological relations of the strata are not determinable due to the absence of finds in them. Fragments of amphorae (*Fig. 18*) dating from the 1st to the 3rd centuries, discovered in and on the Roman spoil, do not determine the time of the Roman abandonment of the quarry.

Excavation results

Trenches 1 and 3 showed the results of the last terracing of the quarry from the end of the 19th century, which completely removed the possible traces of a Roman quarry at this place. Trench 4, in contrast, uncovered fully preserved remains of a Roman quarry, its working terraces formed by breaking blocks and spoil deposits with parts of a Roman building. Judging by these remains, there is a reasonable assumption that the remains of a Roman quarry west of the modern quarry are still fully preserved under thick deposits of post-Roman and modern quarry rubble.

Roman ceramics

PN 1, 2 – Trench 4/SE 09 (*Fig. 18* :1, 2):
– Fragments of the mouth, handle, and wall of possibly the same flat-bottomed amphora of the Forlimpopoli type, version C; ceramic mass soft, fine-grained, sparse inclusions (fine or coarse grains of crushed pottery, fine grains of calcite, very fine mica flakes, fine particles of quartz); sandy fracture; the colour of the outer surface very pale brown to reddish yellow (10YR 7 / 4-7.5YR 7/6); fracture colour reddish yellow (5YR 6/6). Reconstr.

[52] Unpublished report: D. Češarek and M. Horjak, *Preliminarno poročilo o arheološkem dokumentiranju ob izgradnji kanalizacijskega sistema v ks Podpeč - Preserje, občina Brezovica,* 2012 (kept by ZVKDS, OE Ljubljana).

rim diam. 8.5 cm, preserved height 17.5 cm (*Fig. 17*). *Dated:* 1st, 2nd to the first half of the 3rd century; production began in the pottery workshops of the Emilia Romagna region, also documented in Etruria, Umbria, Picenum, and Veneto; amphorae were discovered in northern Italy, in the settlements and cemeteries of Pannonia, in Upper Moesia and Dacia, on Crete, in shipwrecks of the eastern Adriatic.[53]

PN 3 – Trench 4/SE 9 (*Fig. 18: 3*):
– Fragment of amphora handle, oval cross-section; ceramic mass soft, fine-grained, sparse inclusions (fine grains of crushed pottery, very fine grains of calcite, very fine sheets of mica); sandy fracture; outer surface colour reddish yellow (7.5YR 6/6); fracture colour reddish yellow (5YR 6/6). Preserved length 3.3 cm, width 3.9 cm.

PN 4 – Trench 4/SE 9:
– 102 fragments of amphora walls (ceramic mass same as for PN 2) of 0.5 to 3 cm in size.

PN 5 – Trench 4/SE 9:
– 3 small fragments of amphorae (ceramic mass same as for PN 2).

GEOLOGICAL CHARACTERISTICS OF THE PODPEČ QUARRY

In the geological sense, the wider Podpeč area structurally belongs to the External Dinarides tectonic unit, more precisely to the Hrušica nappe.[54] The stratigraphy of Krim hills (*Figs. 19; 20*) mainly consists of Upper Triassic, Lower and Middle Jurassic shallow marine carbonates.[55] Following the terminology of Dozet and Strohmenger,[56] the succession lithostratigraphically consists of the Upper Triassic Main Dolomite Formation, the Lower Jurassic Podbukovje Formation, and the Middle Jurassic Laze Formation.[57] Within the quarry and on Sv. Ana Hill, the last two formations are present.

The Main Dolomite Formation is characterised by alternating beds of dolomite reflecting sedimentation in a shallow marine environment and on tidal flats. Characteristic are wavy laminae (stromatolites).[58] The Lower Jurassic Podbukovje Formation is further divided into four members. Stratigraphically the lowest is the Krka Limestone Member, characterised by evidence of intertidal exposure and the predominance of dense light grey limestone without fossils or other clasts.[59] The proportion of ooids and bioclasts (mainly bivalves and gastropods) gradually increases upwards in succession. Thus, in the Orbitopsella Limestone Member, oolithic limestone is common in addition to the micritic limestone. A more significant proportion of tangential ooids and the first occurrence of the foraminifera genus *Orbitopsella* are characteristic of this member. At the transition to the Lithiotid Limestone Member, darker biogenic limestones start to predominate, together with oolithic limestone. Bioclasts in the Lithiotid Limestone Member are bivalve shells, gastropods, brachiopods, various foraminifera, and other fossils. Especially characteristic are lithiotid bivalves and small megalodontid bivalves. Both groups of bivalves occur in several beds and levels. Coated grains (i.e., oncoids and corticoids) are also common. According to Dozet and Strohmenger, the Lithiotid Limestone Member vertically and laterally passes into the Oolithic Limestone Member. The Podbukovje Formation ends with platy to thin-bedded, dark and dense micritic limestone with rare echinoderm (crinoid) plates. This unit is called the Spotty Limestone Member, which the Middle Jurassic Laze Formation eventually succeeds. Relatively large ooids are characteristic of the Laze Formation, at least some of which have a radial structure and show lighter colour variations than the last three Podbukovje Formation members.[60]

In the area of the Podpeč quarry outcrops, the Lithiotid Limestone Member and just above the quarry also the Spotty Limestone Member and limestones and dolomites belonging to the Laze Formation (*Fig. 19*). However, we did not distinguish the Oolithic Limestone Member from the Lithiotid Limestone Member because thick layers of oolithic limestone also occur within the latter. In contrast, in some other places (e.g., near the Krka village in Suha Krajina), lithiotids occur up to the contact with the Spotty limestone Member.

Of all the stratigraphic units mentioned, the Lithiotid Limestone Member is most extensively studied.[61] Facies types were partly described by Ramovš,[62] while detailed microfacies descriptions were carried out in the northern part of the modern quarry.[63] Limestone beds in the Podpeč

[53] Panella 2002; Aldini 2000; Jurišić 2000.
[54] Placer 2008.
[55] Buser, Grad, Pleničar 1967; Buser 1968; Miler, Pavšič 2008.
[56] Dozet, Strohmenger 2000.
[57] Gale, Keleman 2017, sensu Dozet, Strohmenger 2000.
[58] Miler, Pavšič 2008.
[59] Ogorelec 2009.
[60] Gale, Kelemen 2017, sensu Dozet, Strohmenger 2000.
[61] Buser, Debeljak 1995; Debeljak, Buser 1997.
[62] Ramovš 2000.
[63] Gale 2015.

Quarry dip almost vertically to the south and extend in an east-west direction. In addition to the dip, several sets of differently oriented cracks were also measured, mostly running transverse to the bedding. From the point of view of stone extraction in the area, this is a favourable feature because the crisscrossing of bedding planes and fractures produces naturally formatted blocks.

The lithological variability of limestone types recorded in the Podpeč quarry reflects the rapid lateral and vertical changes common in similar sedimentological environments within the internally differentiated lagoon.[64] The quantity and variety of skeletal grains here are relatively high. Emersion surfaces are present throughout the succession in reddish and yellowish clay fillings and along bedding planes. In a more than 100 m thick composite section (*Fig. 21*), surveyed and sampled from the northernmost tip of Sv. Ana Hill to the base of the Spotty Limestone Member on the southernmost side of the quarry, we described five recurrent facies types (*Fig. 22*) and one facies (6A) that was recorded in a single bed. Facies types may pass laterally into similar types.

Facies types were distinguished on the basis of their colour,[65] texture, and grain types. The texture of limestones defines the geometric and spatial relationships between grains and matrix.[66]

In the stratigraphically lowest part of the succession (Trenches 1, 3, 4, and an outcrop in the basement of the house Podpeč 44, *Fig. 21*), dark micritic limestone (facies type 1B) predominates. Beds are between 10 and 120 cm thick. The most prominent facies of this part of the succession is dark micritic limestone with fragments or whole shells of megalodontid bivalves (facies type 5C). White shells stand out against the dark matrix. These beds are between 38 and 80 cm thick. In the successional continuation, slightly lighter oolithic limestones (facies type 3B) become more common and occur in several layers alongside medium grey limestones (facies 1B). Between Trench 1 and the northernmost surface outcrops, a 7.6 m section remains covered. The section continues on the surface, where light grey limestone varieties initially prevail. The oolithic limestone is a common facies, occurring in beds up to 7 m thick (facies type 3B). Large litiotid bivalves (facies type 5A) in sub-vertical position first appear in a massive, several meters thick bed with an oolithic matrix. This layer is lighter in colour than several other horizons of this facies type higher in the section. Beds and layers of lithiotid limestone range from 60 to 180 cm in thickness. In the succession of the modern quarry, in addition to the beds of ooid limestone, we also logged some beds rich in coated grains, bioclasts and smaller intraclasts (facies type 4A), beds of light and dark grey micritic limestone, and some beds with megalodontid shells. The upper part of the section is characterised by very thick to massive beds of oolithic, micritic and bioclastic limestone. The last bed of the described sequence in the southernmost part of the quarry is followed by a sequence of platy to thin-bedded dark grey micritic limestone with crinoids and/or ooids of radial structure already belonging to the Spotty Limestone Member.

PRODUCTS

Lithological composition of the products made of Lower Jurassic limestone and some other rocks

Concerning the production of the Podpeč quarry, it has always been assumed that it was intended primarily for the supply of the Roman colony of Iulia Emona (present-day Ljubljana), with the Podpeč quarry being by no means the only one satisfying its needs.[67] Characterisation of 288 products discovered in Ljubljana and its immediate surroundings, presently kept in the collections of the National Museum of Slovenia (Narodni muzej Slovenije; NMS)[68] and the City Museum in Ljubljana (Muzeji in Galerije Ljubljane; MGML),[69] built into Ljubljana buildings,[70] or placed in the open air,[71] confirmed several simultaneous

[64] Gale, Kelemen 2017.

[65] Munsell Color (Firm) 2010.

[66] Embry, Klovan 1971.

[67] See Djurić, Rižnar 2017.

[68] Šašel Kos 1997. We thank the management of the NMS, Janka Istenič and Helena Bras for access to the monuments and permission for their sampling.

[69] We truly thank Bernarda Županek for all her precious help in analysing the monuments kept in the City Museum of Ljubljana (MGML).

[70] Šašel Kos 1998; 2018.

[71] We thank the Institute for the Protection of Cultural Heritage of Slovenia, Ljubljana Regional Office (ZVKDS OE Ljubljana) and Mija Topličanec for their help and permission to sample the monuments.

sources of limestone.[72] In addition to the Lower Jurassic limestone bound to Podpeč and presumably Podutik,[73] there is also the Lithotamnian limestone, usually associated with Miocene beds in the Moravče source area, Upper Cretaceous limestone of the Lipica Formation from Aurisina/Nabrežina, Italy[74] and Lower Cretaceous limestone of unknown origin (*Fig. 23*).[75]

Of the 288 analysed products, 185[76] (64.2%) are classified in the Lower Jurassic Podbukovje Formation, which indicates that this very limestone played a major role among the rock types used in Emona. Facies types 3A, 4A, 5A, 5B, 5C and their alternations, represented in 103 products (55.7%), are characteristic of the Lithiotid Limestone Member. Cortoids, oncoids, bivalves (especially megalodontides), and brachiopods are present in these facies, and some fossils with a narrow stratigraphic range, such as the foraminifera *Orbitopsella* or lithiotid shells. As a rule, these facies are not found in other members of the Podbukovje Formation. In contrast, facies types 1A, 1B, 2A, 2B and 3B, representing a total of 79 products (42.7%), also occur in the Krka Limestone Member and the Orbitopsella Limestone Member. The future chemostratigraphic analyses of carbon and strontium isotopes will probably provide a definite age determination of the limestone for the products made from these types. Since the examined products (stelae, urns) from defined facies types show high formal homogeneity with products unambiguously made from limestone originating from Lithiotid Limestone Member, we currently assume that they also belong to the latter member and not to the stratigraphically lower parts of the Podbukovje Formation.

Table 1 gives examples of the classification of selected products from Emona into individual facies types of the Lithiotid Limestone Member. In determining the possible origin, the dimensions of the artefact were considered in addition to lithology and colour.

Three artefacts (1.6%) from the studied group consist of two distinct facies types of the platy limestone of the Spotty Limestone Member.[77] These are the facies of dark grey limestone with crinoids and ooids and the facies of dark grey limestone with crinoids and intraclasts (*Fig. 24*). In the Podpeč area, this member outcrops just above the modern quarry (see *Fig. 19*).

Through geological characterisation, we have identified a group of artefacts (altars)[78] that belong to the same facies type but whose stratigraphic position cannot be precisely determined because of the dolomitisation of the original rocks. They are coarse-grained dolomites with a porous structure (*Fig. 25*). On the individual parts, the original structure of the ooids is preserved.

Based on the detailed geological mapping of the wider Podpeč area, we note that the corresponding lithologically comparable dolomite occurs in two stratigraphic members. Its occurrence is discontinuous and often laterally pinching out. Such

[72] The East Alpine white marble of the Gummern (A) and Pohorje (SLO) quarries is also present in a relatively small proportion in Emona. The inventory also includes the only known inscription made of Upper Carboniferous sandstone from Ljubljana Castle, which was used as the main building stone in Emona; Djurić, Rižnar 2017.

[73] Products from the Lower Jurassic limestone from the Ig/Staje quarry are not included in the inventory based on the place of their discovery, formal properties and specific onomastic features.

[74] Krašna 2019.

[75] First identified in Vodnik 2016.

[76] MGML inv. nos. 3031, 7050, 8711, 8724, 35203, 35204, 35209a, 35209b, 35210, 35211, 35445, 42024, 42248, 47125, 48557, 48560, 48565, 48566, 48572, 48592, 48593, 51180, 51181, 51182, 51185 51187, 52171, 52830, 52831, 52832, 52833, 57722, 57724, 57725, 57726, 57727, 57728, 57729, 57730, 57731, 57733, 57735, 57736, 59816, 59818, 59824, 60174, 60175, 60176, 60176 60180, 60182, 60183, 60184, 60189, 60191, 60202, 60203, 60204, 60205, 60207, 60209, 60210a, 60210b, 60213, 60216, 61457, 62390, 61457, 62779, 62786, 63840, 78886, 78887 97928; some parts of the columns in MGML that are currently without inv. nos., have our internal EMN number 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22; NMS inv. nos. L31, L32, L35, L36, L37, L39, L40, L42, L48, L54, L56, L58, L62, L64, L71, L 76, L77b, L78, L83, L84, L85, L87, L88, L128, L 141, L144, L147, L160, L164, L166, L187, L188, L191, L198, L209, L201, L210, L224, L225, L226, L227, L228, L229, L230 / 232, L231, L235, L236, L239a, L239b, L250–L272; 3 monuments from Dolničar's lapidary (Šašel Kos 1998, nos. 1, 7, 14); 3 monuments in the Križanke lapidary and one in the Gorenjski Muzej (Šašel Kos 2018, 20–21, 21–23, 25, 28); 6 pieces along Aškrčeva road 1– cover and repair of the sewer from the Emona road E (Plesničar Gec 1999, Fig. 38); stela for Antonia Maximila at Ljubljana Castle; 4 pieces of platform from the Emona road B (Plesničar Gec 1999, Fig. 87) on Turnograjska ulica (street); two thresholds and base of the composite altar in the Mirje Archaeological Park; a rectangular block and part of the epistle from the Emona forum (Plesničar Gec 2006, Fig. 44) in front of the Pod lipco inn.

[77] Facies To-1 MGML inv. no. 61457 – cover, facies To-2 MGML inv. no. 51182, NMS inv. no. L45.

[78] NMS inv. no. L34, NMS inv. no. L60, NMS inv. no. L61, NMS inv. no. L63.

dolomites are locally present on the eastern slope of Sv. Ana Hill, namely at the transition from the Lithiotid Limestone Member to the Spotty Limestone Member, and in the middle and upper parts of the Laze Formation. In both cases, the original rock was mostly oolithic limestone.

Roman products of the Podpeč quarry

Podpeč production has very different products made from dimension stone; in some cases, it also is used as building stone (paving, stone blocks and slabs, etc.). The actual extent of this kind of use in Emona is challenging to estimate, as there has been no systematic documentation and storage of stone blocks and slabs thus far. However, from the published excavations, especially by Walter Schmid[79] and Ljudmila Plesničar Gec,[80] it can be concluded that the use of such pieces was quite widespread in Emona.[81] Many different elements stored in the MGML depot and the architectural items that are not fully covered in our inventory show their widespread use. Therefore, the number of architectural parts and parts of different structures should be corrected in favour of the first group compared to the number of movable monolithic products, as shown in our inventory (46% vs 54%). We cannot reliably determine the total production volume of the Podpeč quarry. Nevertheless, if we use a calculation made for the production of sarcophagi,[82] according to which about 1.5% of the total output is preserved, we can assume that the Podpeč quarry in only three centuries produced more than 11,500 different products for Emona.[83]

For analysis, we divided products from the Podpeč quarry into various single orders: architectural elements (bases, shafts and capitals of columns, parts of entablatures, *loricae*) and different parts of city equipment (paving, sewers, rampart equipment) and buildings (thresholds, stairs, paving, *crustae*) (*Fig. 26*), as well as serial products (altars, stelae, inscription plates, boundary stones, sarcophagi, above-ground and buried ash-chests and above-ground and buried urns) (*Fig. 27*). In chronological terms, products that bear various inscriptions (altars, stelae, inscription plates) or are formally and typologically determinable (stelae) are identifiable. Grave urns and ash-chests are identifiable with external elements when their contents are preserved and documented. At the same time, various architectural parts can be determined chronologically based on their original contexts, which are rare or rarely adequately documented in Emona.[84] A comprehensive typological chronological analysis of the architectural elements from Emona has not yet been made.

The monuments included in the inventory were made of Lower Jurassic limestone of different facies types (layers) in unequal proportions (*Fig. 28*). Our analysis showed that the most common choice was facies type 1B with more than a quarter (26.1%) share, followed by facies type 5C with almost a fifth (18.5%), facies type 2B with more than a tenth (13 %) share and facies type 4A with nearly a tenth share. All other facies types are represented in the corpus with much smaller percentages. Differences in the material of individual facies types can be explained on the one hand by the degree of their occurrence within the quarry, and on the other hand as a possible consequence of the selection of stonecutters related to the special properties of layers in the quarry. Among the analysed monuments, only 31 (10.8%) are chronologically determined, of which at least 18[85] (58%) were made in the 1st century, 9[86] (29%) in the 2nd century and 4[87] (13%) in the 3rd century (*Fig. 29*).

This group of thirty-one monuments was made of rock, which we can place in eight of the ten facies types identified in the Podpeč quarry (1A and B, 2B, 3A and B, 5A, 5B and 5C), but in unequal quantities (*Fig. 30*). In the 1st century, only five facies types (1B, 2A, 3A, 3B and 5C) were used to make them; a rock shows transient facies in three cases of them (1B/5B, 1B/5C).[88] This selection of layers or facies types in principle makes it possible

[79] Schmid 1913.

[80] Plesničar Gec 1999.

[81] See, e.g. numerous thresholds in Schmid 1913.

[82] Koch 2015, 154–157.

[83] We should bear in mind that recycling stone products in urban environments, especially in the Late Roman period, was very high.

[84] Data of this kind are expected from the latest, as yet unpublished excavations led by MGML.

[85] MGML inv. no. 63840; NMS inv. nos. L32, L35, L36, L37, L40, L48, L54, L84, L87, L88, L164; Dolničar lapidary, Šašel Kos 1998, nos. 1, 6, 14; Križanke lapidary, Šašel Kos 2018, Figs. 5; 10; 12.

[86] NMS inv. nos. L31, L56, L58, L78, L128, L144, L160; Gorenjski muzej, Šašel Kos 2018, 21; stela for Antonia Maximila, Ljubljana Castle.

[87] MGML inv. nos. 48560, 52833; NMS inv. nos. L42, L166.

[88] NMS inv. nos. L32, L37, L164.

to determine the most probable place of initial limestone exploitation in Podpeč.

The analysis of architectural parts (all parts of columns, *loricae*), ash-chests and urns, which cannot be unambiguously defined chronologically, shows an interesting preferential use of some facies types (layers) for individual product groups (*Fig. 31*). The most obvious is the preferred use of facies type 5C for columns, undoubtedly for decorative reasons,[89] which is indirectly evidenced by the use of mainly facies types 1B and 3B for the production of column-like elements – *loricae*, among which we do not know those made of limestone of facies type 5C. Similarly, for the production of urns that have been made from layers of almost all facies types, we can identify the preferred use of facies types 2B and 4A.

From a formal and typological point of view, we can better define only stelae and, to some extent, urns, and partly also columns and parts of entablatures among the products. The earliest preserved stelae, which were made from the Augustan period until the end of the 1st century (*Fig. 32*), have forms related to the production of the Aurisina quarry, which is strongly present in the 1st century Emona with its products. Such are the three stelae in the form of a simple rectangular plate,[90] one for the veteran of the legio XV *Lucius Oclatius Tarquiniensis* (*Fig. 32:* 1),[91] the other for the *Accepta* and others (*Fig. 32:* 2)[92] and the third for another veteran of the legio XV *Lucius Obulsius* (*Fig. 32:* 3).[93] In the early production of the Aurisina quarry, this simple form of the stele is one of the most common,[94] and a similar inscription plate of *Vibunnia Matrona* (*Fig. 32:* 4)[95] could also be included in this group. The group is followed by four profiled stelae of edicular design (*profilgerahmte Giebelstele*), common in Aurisina production.[96] These are the stela for *Caius Iulius Quadratus* (*Fig. 32:* 5),[97] the stela for *Caius Marcius Dignus* (*Fig. 32:* 7),[98] the stela for the soldier *Pudentius* (*Fig. 32:* 8)[99] and the stela for *Quintus Polius Vitalis* (*Fig. 32:* 6).[100] The decoration of these stelae focuses only on their upper parts. It includes motifs of half-palmettes, dolphins, sea gryphons and rosettes, typical or at least known on Aurisina products of this kind.[101] The third group consists of two architectural stelae of developed form with smooth half-pilasters and Corinthian capitals: the stela of the legio XV veteran *Titus Varius* (*Fig. 32:* 9)[102] and the stele of *Primus* (*Fig. 32:* 10),[103] both decorated with dolphins in corner fields and rosettes in gables. Such stelae are usually richly decorated in Aurisina production and are characteristic and common.[104] All identifiable stelae (Nos. 5, 6, 8, 9, 10, except Nos. 3 and 7 in *Fig. 32*) have the backside not worked.

Urns from Emona cemeteries have not been studied so far.[105] The group of buried urns, which could be attributed to Podpeč production, may be divided into rectangular, cylindrical, situla-like and situla-like with a base. The former has a flat lid, which is often a simple, unformed stone slab, and the latter have a flat or domed cover, which can also be assumed for the situla-like urns with a base.[106] These urns are Podpeč copies of imported urns

[89] See findings in Djurić, Gale, Miletić 2018.

[90] Ungegliederte Stele IIIa, Pflug 1989, 34; ungegliederte Schaft Ia, Cigaina 2016, 76.

[91] Šašel Kos 1998, no. 6, 336–337; *lupa* 4202.

[92] Šašel Kos 2018, 20; *lupa* 4196.

[93] MGML inv. no. 63840; A. Gaspari, *Nova nagrobna stela za veterana 15. Apolonove legije iz Emone* (in preparation).

[94] See e.g. Lettich 2003; *lupa* s.v. Aquileia.

[95] NMS inv. no. L32; Šašel Kos 1997, no. 60, 230–232; *lupa* 1158.

[96] E.g. from Aquileia Lettich 2003, no. 87, 110, 140.

[97] Šašel Kos 2018, 27; *lupa* 3704.

[98] NMS inv. no. L84; Šašel Kos 1997, no. 53, 218–220; *lupa* 3705.

[99] NMS inv. no. L164; Šašel Kos 1997, no. 37, 185–186; *lupa* 4190.

[100] NMS inv. no. L54; Šašel Kos 1997, no. 55, 222–223; *lupa* 3708. The eagle in the pediment of the stele is the usual decoration of stelae of Hadrianic period.

[101] Half-palmettes rarely appear on simple stelae in Aurisina production (e.g. Lettich 2003, no. 378, Ronchi dei Legionari; *lupa* 14050), but more often on richer architectural stelae, e.g. Museo d'Antichità Trieste, inv. no. 8503 (Vidulli Torlo, Mainardis 2001, 65; *lupa* 16193), NMS inv. no. L43 (Šašel Kos 1997, no. 51; *lupa* 3702), stela from Šmarata in Snežnik Castle (Krašna 2019, no. 22; *lupa* 3665). Dolphins with a rosette are a standard decoration of Aurisina stelae (e.g. Lettich 2003, nos. 87, 278, 403; *lupa* 14477, 14068, 14418). The sea gryphon is known in Aurisina production only from two architectural stelae – Lettich 2003, no. 118; *lupa* 14018; and *INSCAQU* 940; *lupa* 19597.

[102] NMS inv. no. L48; Šašel Kos 1997, no. 39; *lupa* 3689.

[103] Šašel Kos 2018, 28; *lupa* 20797.

[104] Lettich 2003, nos. 95, 116; *lupa* 14020, 14475; Vidulli Torlo, Mainardis 2001, 65; *lupa* 16193; Šašel Kos 1997, no. 51; *lupa* 3702.

[105] They were considered only in the context of the publications of the Emona cemeteries (Petru 1972, especially p. 14; Plesničar Gec 1972) as one of the forms of cremated burial.

[106] See e.g. the urn with leg from Aurisina in Giovannini 2015, Fig. 12.

from Aurisina, which are often found in Emona cemeteries. Only two urns are reliably dated with the coins discovered in them: the urn from tomb 103 with the as of Claudius I.[107] and the situla-like urn from tomb no. 746 with Nero's as.[108] The particular shape of the above-ground cylindrical urns (and pseudo-urns) discovered in Emona mimics a cylindrical wicker basket.[109] Such urns, made of Aurisina limestone and dating to the 1st century, are also known at Aquileian cemeteries.[110]

Judging by the preserved parts of the columns and parts of the entablatures, the Tuscan order prevailed in Emona architecture. In only two cases[111] do the preserved column shafts show an Ionic form. All the preserved capitals and bases of the columns, made in Podpeč limestone, belong to the Tuscan order, as do parts of the preserved friezes.[112] The height of the columns, measurements based on their diameters,[113] is between 2.4 and 3 m. The Tuscan order is quite widespread in *regio X Venetia et Histria* in the period going from the middle of the 1st century BCE to the middle of the 1st century.[114]

CONCLUSIONS

The fundamental question of whether we can speak of a Roman quarry in Podpeč has been answered affirmatively with the discovery of Roman remains in the Trench 4. The evidence of a Roman quarry at this spot is not so much the remains of a Roman building, which, judging by the layer of sand on the floor, could also be part of a warehouse for ceramic products (amphorae?), as the thick fillings of quarry waste rubble (*Halde*) next to it and terraced bedrock. Regarding the size of the Roman quarry, we can, for now, rely only on circumstantial evidence. Some derive from the specific location of the first buildings in Podpeč in the NW slope of the Sv. Ana Hill that is, in the space created by the removal of stone material, as this situation shows the Josephine military map, made in the years 1763 to 1787.

Further circumstantial evidence comes from the analysis of limestone microfacies in Podpeč and their correlation with the same analyses of Roman products discovered in Ljubljana. The microfacies of the Lower Jurassic limestone documented in Podpeč and the dolomite of the Middle Jurassic Laze Formation adjoining them all appear in products from Emona. In the stratigraphic sequence of the strata in Podpeč (see *Fig. 21*), the facies found in the products belonging to the Lithiotid Limestone Member is concentrated in two areas. The first such area belongs to the stratigraphically oldest part of the sequence in the northernmost part of the quarry in Podpeč.[115] There, facies types appear in layers of a thickness comparable to the final size of the products themselves. Another such section can be identified in the central part of the succession,[116] which was logged on the eastern and western parts of the modern quarry. Since the eastern slope was withdrawn towards the slope of the Sv. Ana Hill and as such relatively inaccessible for quarrying, another suitable area for stone extraction was located on plots nos. 937, 960, 961 (farms nos. 6–8; *Fig. 2*). In this part, limestone has very thick to massive beds.

The highest probability of the early existence of a Roman quarry in the northernmost part of the quarry, rather than in its central part, is indicated by the frequency of limestone facies types 1B and 5C within the analysed product group: facies types 1B and 5C, which are common in the northern part of the profile, also predominate here. Additionally, the earliest known products from Emona can identify the initial area of Roman extraction. In most of the earlier monuments, the backside is unworked,[117] so that the minimum bed thickness in the monuments is comparable to the bed thickness in the northern part of the Lithiotid Limestone Member succession. At the same time, the beds of the corresponding facies in the central part of the quarry are mostly too thick, which allows us to define that part of the Lithiotid Limestone

[107] Petru 1972, 28; *RIC* 66 E.

[108] Plesničar Gec 1972, 253; *RIC* 319.

[109] MGML inv. no. 42024; Plesničar 1977; NMS inv. nos. L59, L76; Bertoncelj Kučar 1985, 256–257; Šašel Kos 1997, 483; one urn is made from Neogene lithotamnian limestone, the other in Podpeč limestone.

[110] Scrinari 1972, 105–106; Buora 1982.

[111] MGML inv. nos. 52830, 60175.

[112] Parts of the entablature of the colonnade of the third construction phase of the Emona forum, according to Plesničar Gec 2006, 53, Fig. 42b. The uncovered part stands today in front of the entrance to the Pod lipco inn.

[113] The proportions of the Tuscan column are: base height ½ ϕ, body height 6 ϕ, capital height ½ ϕ.

[114] Cavalieri Manasse 1978, 44; Sacchi 2017.

[115] Facies found in Trenches 1, 3 and 4.

[116] In Fig. 4 above the Gale 2015 profile.

[117] See *Fig. 37*.

Member succession in the Podpeč quarry that is the most suitable for the start of stone exploitation in this area. Thus, the location of the first quarry corresponds to the oldest part of the sequence and can be spatially located at the north-northwestern edge of the Sv. Ana Hill (*Fig. 33*), in the area of plot no. 932 (farm no. 3, *Fig. 2*; Trček and *Fig. 33*).

However, it is reasonable to expect that the extraction of stone blocks continued over time in several places, perhaps even in continuation along the entire edge of the slope to the southwest, to a point marked on the Josephine military map by the westernmost farm in Podpeč. This hypothesis is also confirmed by the characterisation of individual products made from facies types 1A and 5A. The corresponding facies types occur only in the central part of the section, a good 25 m higher than the sequence described in the trenches. In addition to products from the Lithiotid Limestone Member, products from the Toarcian Spotty Limestone Member and the dolomitised limestones and dolomites probably belong to the Middle Jurassic Laze Formation.

Regarding the products of the Podpeč quarry, some crucial facts can be established. First, the quarry satisfied all of Emona's specific needs for dimension stone products and partially building stone. The requirements and possibilities of the town and its inhabitants for stone products have undoubtedly fluctuated considerably over the centuries, which was directly related to their respective economic capacity.[118] The greatest needs and thus the greatest production of the quarry can rightly be expected in the period of the town's foundation and for some time after it, which is confirmed by chronologically identifiable products. At the same time, the early Podpeč products show such pronounced similarities with the products of the Aurisina quarry, which were also strongly present in Emona in the 1st century, that we can use them to substantiate the hypothesis of the arrival of stonemasons who started operating in Podpeč from the Aurisina quarry.

[118] Compare data on monetary circulation in Emona: Kos 1986; 2006.

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Slikovno gradivo: Sl. 3 (izdelava: Edisa Lozić, Inštitut za arheologijo ZRC SAZU). – *Sl. 6* (foto: M. Vrabec). – *Sl. 7, 8, 11, 12, 14, 15, 17* (foto: B. Djurić). – *Sl. 10* (3D model: Gregor Kočar, Filozofska fakulteta, Univerza v Ljubljani). – *Sl. 16* (risba: E. Lozić, B. Djurić). – *Sl. 18* (risba: Jerica Brečič, Arhej d.o.o.). – *Sl. 19* (DMR: E. Lozić; interpretacija: R. Brajkovič). – *Sl. 21* (izdelava: L. Gale, R. Brajkovič). – *Sl. 22* (foto: L. Gale, R. Brajkovič). – *Sl. 24, 25* (foto: R. Brajkovič). – *Sl. 33:* (izvedba: Mateja Belak, ZRC SAZU, Inštitut za arheologijo).
Illustrations: Fig. 3 (Elaborated by Edisa Lozić, Inštitut za arheologijo ZRC SAZU). – *Fig. 6* (photo: M. Vrabec). – *Figs. 7, 8, 11, 12, 14, 15, 17* (photo: B. Djurić). – *Fig. 10* (3D model: Gregor Kočar, Filozofska fakulteta, Univerza v Ljubljani). – *Fig. 16* (drawing: E. Lozić, B. Djurić). – *Fig. 18* (drawing: Jerica Brečič, Arhej d.o.o.). – *Fig. 19* (DMR: E. Lozić; interpretation: R. Brajkovič). – *Fig. 21* (elaborated by L. Gale, R. Brajkovič). – *Fig. 22* (photo: L. Gale, R. Brajkovič). – *Fig. 24* (photo: R. Brajkovič). – *Fig. 33* (processing by Mateja Belak, ZRC SAZU, Inštitut za arheologijo).