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Gomile dolenjske halštatske skupine: geoarheološka reinterpretacija stratigrafskega zapisa

Tumuli of the Dolenjska Hallstatt Group: A Geoarchaeological Reinterpretation of the Stratigraphic Record

Agni PRIJATELJ, Helena GRČMAN, Lucija GRAHEK

Izvleček

Prispevek obravnava potencial geoarheoloških metod pri preučevanju gomil dolenjske halštatske skupine in, na podlagi sinteze dosedanjih raziskav in novih analitskih pristopov, predlaga geoarheološki okvir za interpretacijo njihove stratigrafije. V ospredju sta primerjava različnih modelov gradnje gomil in umeščanja grobov vanje ter analiza gradbenih materialov. Predstavljeni teoretični modeli kažejo raznolikost gradbenih praks – od enkratnega nasutja do večfaznega povečevanja gomil in uporabe različnih gradiv, vključno z rušo. Raziskave na Pezdirčevi njivi v Podzemlju ponazarjajo potencial geoarheoloških metod pri preučevanju erodiranih gomil in rekonstrukciji dolgoročnih pedosedimentarnih procesov. Primerjava stratigrafskih podatkov z 11 najdišč opozarja na vpliv pedogenih in sedimentacijskih procesov na ohranjenost in interpretacijo stratigrafskega zapisa ter na pomen sistematičnega vključevanja geoarheoloških analiz v prihodnje raziskave gomil.

Ključne besede: grobne gomile; dolenjska halštatska skupina; stratigrafija; pedosedimentarni procesi; geoarheologija; mikromorfologija; pedološke analize; geomorfologija

Abstract

This paper explores the potential of geoarchaeological methods for the study of tumuli of the Dolenjska Hallstatt group and proposes a geoarchaeological framework for interpreting their stratigraphy, based on a synthesis of previous research and new analytical approaches. It compares models of burial mound construction and grave incorporation and examines the construction materials used. The theoretical models reveal diverse construction practices, ranging from the deposition of a single mound fill to multi-phase enlargement and the use of different materials, including turf. Research at the Pezdirčeva njiva cemetery in Podzemelj demonstrates the potential of geoarchaeological methods for investigating eroded mounds and reconstructing long-term pedo-sedimentary processes. Stratigraphic data from 11 sites highlight the effects of pedogenic and sedimentary processes on the preservation and interpretation of the stratigraphic record and the importance of integrating geoarchaeological analyses into future research on tumuli.

Keywords: burial mounds; Dolenjska Hallstatt group; stratigraphy; pedo-sedimentary processes; geoarchaeology; micromorphology; soil analyses; geomorphology

Geoarheološke metode obravnavajo arheološke plasti kot artefakt (Miller 2011, 104) in temeljni vir podatkov o človekovih dejavnostih ter naravnem okolju. Stratigrafski zapis preučujejo z metodami, kot so mikromorfologija, sedimentološke in pedološke analize ter geofizikalni pristopi, pogosto v povezavi s paleookoljskimi raziskavami (Goldberg, Macphail 2006; Rapp, Hill 2018; Karkanas, Goldberg 2019).

V evropskem prostoru in širše je geoarheologija v zadnjih desetletjih pomembno prispevala k razumevanju gomil (Goldberg, Macphail 2006,

227–235; Macphail, Goldberg 2018, 224–226; Karkanas, Goldberg 2019, 219–221). Analize gradbenih materialov kažejo, da so bile gomile grajene iz različnih sedimentov in zemljin lokalnega ali bolj oddaljenega izvora ter z antropogenimi in biogenimi materiali.[1] Prepoznani so primeri enkratnega nasipanja z naravnimi materiali, uporabe različnih kombinacij gradiv in večfaznega oziroma generacijskega povečevanja gomil (npr. Clay 1986; Kidder, Ortmann, Allen 2004; Cremeens 2005; Sherwood, Kidder 2011; Hejcman et al. 2013; Borisov et al. 2019; Kabała et al. 2019; Cannell, Bill, Macphail 2020; Cannell 2021; Gkouma, Karkanas, Iacovou 2021; Cseh et al. 2022; Khokhlova et al. 2022).

Med naravnimi materiali so bili najpomembnejši razni tipi sedimentov, zemljin in ruše. Ti so s svojimi mehanskimi danostmi in omejitvami določali strategije gradnje. V primeru uporabe zemljin in sedimentov je nasipavanje, po predhodnem izkopu izbranega nevezanega gradiva, potekalo z manjše višine, najverjetneje s pomočjo lopat, košar in raznih večjih posod (npr. Cremeens 1995; 2005; Cremeens, Landers, Frankenberg 1997; Papadopoulos, Bejko, Morris 2008; Sherwood, Kidder 2011; Ortmann, Kidder 2013), v primeru monumentalnih struktur pa tudi pomožnih klančin in vozov (npr. Ortmann, Kidder 2013; Gkouma, Karkanas, Iacovou 2021). Način odlaganja zemljin in sedimentov je vplival na nastanek sedimentacijskih struktur, identičnih naravnim procesom na pobočju. Gravitacijsko premikanje gradiva med gradnjo je lahko povzročilo suhe tokove, plazenje ali inverzno sortiranje gradiva, ki so prepoznavni s pomočjo mikromorfološke analize (Karkanas et al. 2012, 2728–2730; Gkouma, Karkanas, Iacovou 2021, 611–612; Gaggioli, Van Damme 2025, 15, sl. 7). Pri gradnji večjih gomil so bile lahko uporabljene tudi dodatne tehnike priprave gradiva, kot so močenje (npr. Cremeens 2005, 591–593, sl. 5; Gkouma, Karkanas, Iacovou 2021, 612, sl. 8) ali izmenjevanje različnih vrst zemljin in kompakcija, kar je izboljšalo stabilnost konstrukcije ter privedlo do nastanka specifičnih mikromorfoloških struktur v gradivu (Sherwood, Kidder 2011; Gkouma, Karkanas, Iacovou 2021; Gaggioli, Van Damme 2025; Khokhlova et al. 2022).

Pomemben gradbeni material je bila tudi ruša, ki se je rabila v različnih prazgodovinskih gomilnih tradicijah (Macphail et al. 1998; 2013; Holst, Breuning-Madsen, Rasmussen 2001; Van Nest et al. 2001; Robin 2010; Doorenbosch 2013; Breuning-Madsen et al. 2016; Parzinger 2017; Borisov et al. 2019; Cannell 2021; Makeev et al. 2021). Ruša je kompoziten naravni material, ki ga tvori vrhnja plast zemljine, poraščena z rastlinjem, še zlasti travo. Ta z gostim koreninskim sistemom veže zemljino (A- in vrhnjega dela E- ali B-horizonta[2]) in preprečuje njeno razsutje. Omenjene lastnosti materiala so zahtevale drugačno predpripravo in drugačen način gradnje: v nasprotju z izkopavanjem in nasipavanjem nevezanih zemljin in sedimentov se je rušo rezalo v različno oblikovane režnje in nato bolj ali manj sistematično zlagalo v kopo polkrogle oblike.

Geoarheološke raziskave kažejo različne načine uporabe tega materiala: od gradnje celotnih gomil do uporabe ruše zgolj v jedru gomile ali delu plašča (Breuning-Madsen, Holst 1998; Breuning-Madsen, Rønsbo, Holst 2000; Doorenbosch 2013; Cannell, Bill, Macphail 2020; Makeev et al. 2021). Prepoznavanje ruše v stratigrafskem zapisu je odvisno od lastnosti izvornih tal in poznejših pedogenih procesov. V dobro ohranjenih primerih so posamezni režnji vidni kot izmenjujoče se svetlejše in temnejše plasti, vendar jih lahko intenzivni procesi mineralizacije organskega gradiva in pedogeneze sčasoma zabrišejo ali popolnoma homogenizirajo (Borisov et al. 2019, 129; Makeev et al. 2021). To predstavlja pomembno omejitev

[1] Med antropogeno gradivo, dokumentirano znotraj gomil, sodijo na soncu sušeni zidaki (Khokhlova, Nagler 2020; Mikhaylova et al. 2025) in apneni premazi (Gaggioli, Van Damme 2025, 7, 11, 16), med biogeno pa namerne ali nenamerne primesi živalskega gnoja (Macphail et al. 1998, 638–640, sl. 9; Khokhlova et al. 2022, 412, sl. 9: e,f).

[2] Horizont je sloj tal, ki je večinoma vzporeden s površino tal in je nastal s tlotvornimi procesi. Od zgoraj ali spodaj ležečih slojev tal se razlikuje v eni ali več morfoloških, fizikalnih ali kemijskih lastnostih. Pet osnovnih horizontov tal vključuje horizonte O, A, E, B in C. Horizont O nastane z akumulacijo organske snovi na površini tal v aerobnih razmerah in vsebuje več kot 35 % organske snovi. Horizont A nastane v zgornjem delu talnega profila in je navadno temnejši kot horizont, ki leži pod njim. Vsebuje manjši deleže organske snovi kot horizont O, ki je v prevladujočem delu tudi že humificirana in mineralno vezana. Horizont E je običajno svetlejši od horizonta O ali A nad njim in ima zaradi procesov izpiranja manjšo vsebnost gline, organske snovi ali seskvioksidov kot iluvialni horizont pod njim. Horizont B nastane s preperevanjem mineralov matične podlage in s tvorbo sekundarnih mineralov na mestu samem. Običajno leži pod horizontoma O in A nad matično podlago in je različno obarvan, npr. rjavo, rumenorjavo ali rdečerjavo. Horizont C je mineralni horizont nesprijetega gradiva ali zdrobljene matične podlage, iz katere so tla nastala. Ne kaže znakov tlotvornih sprememb in leži pod horizonti A, E ali B.

pri interpretaciji starejših stratigrafskih opisov, pri kateri značilnosti gradbenih faz, uporabljeni materiali in poodložitveni procesi pogosto niso bili sistematično dokumentirani.

Pokopana tla pod gomilami so pomemben vir podatkov o okolju, saj gomilno nasutje pogosto ohrani stanje tal iz časa njihove gradnje. Analiza pokopanih tal omogoča rekonstrukcijo paleookolja, v pomoč pa je tudi pri prepoznavanju poznejših pedogenih in sedimentacijskih procesov, ki so preoblikovali gomilni zapis (Dreibrodt et al. 2009; Doorenbosch 2013; Hejcman et al. 2013; Hildebrandt-Radke et al. 2019; Kabała et al. 2019; Makeev et al. 2021; Khokhlova et al. 2022; Sverchkova, Khokhlova 2025; Mikhaylova et al. 2025).

Geoarheološki pristop tako omogoča natančnejšo interpretacijo stratigrafije gomil, saj jo povezuje z analizo gradbenih materialov, tehnologij gradnje, paleookolja in naravnih procesov po nastanku gomil. Prav vsaka gomila uteleša niz načrtovanih odločitev in korakov, od izbire in zasnove delovišča na prostoru grobišča, organizacije dela, izbire in pridobivanja gradbenega materiala, različnih tehnologij gradnje, pa vse do namenskega vzdrževanja in skrbi za zunanji izgled gomile (Sherwood, Kidder 2011, 83–84). Integracija mikromorfologije in drugih geoarheoloških metod v raziskave gomil omogoča tudi vpogled v širše procese interakcije med prazgodovinskimi skupnostmi in njihovim okoljem ter v konstrukcijske veščine, vezane na gradnjo grobnih spomenikov z različnimi naravnimi, antropogenimi in biogenimi materiali. Takšen geoarheološki pristop hkrati prispeva še k razumevanju potencialnih simbolnih pomenov izbranega gradbenega materiala, vezanih, na primer, na njegove vizualne in taktilne lastnosti, provenienco ter težavnost pridobivanja (Cannell 2021, 698–701).

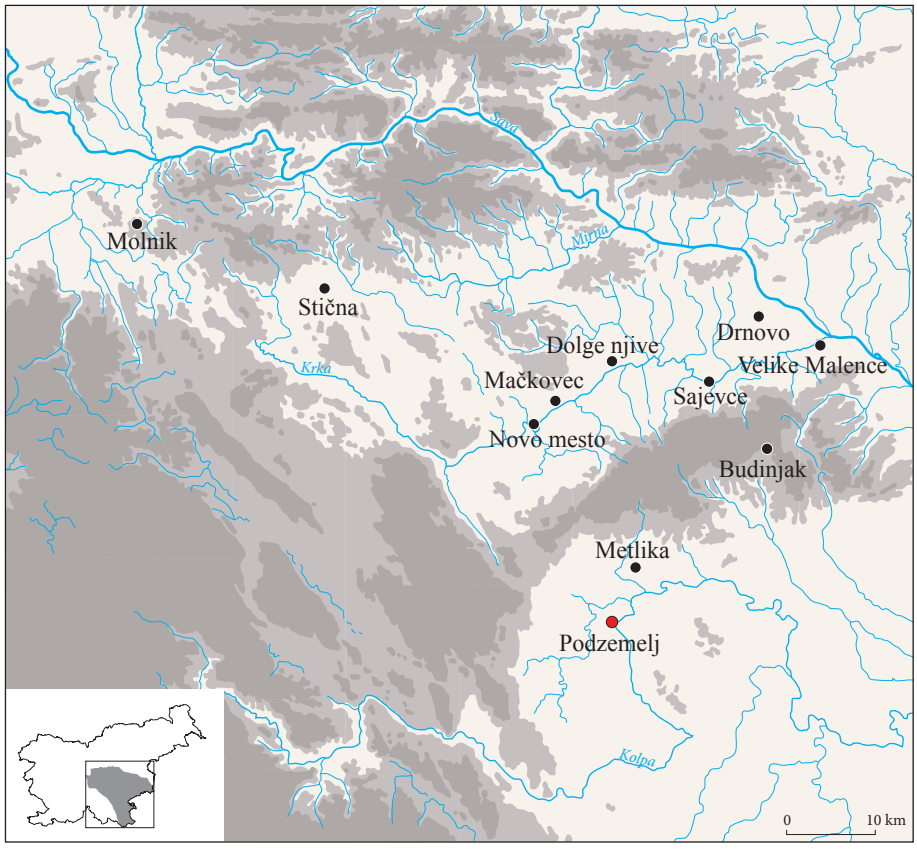
Geoarheološke raziskave grobnih gomil na Slovenskem so bile do nedavnega osredotočene predvsem na analizo lidarskih podatkov in uporabo geofizikalnih metod (npr. Mušič, Črešnar, Medarić 2014, 32–34; Mušič et al. 2015, 47–57; Mušič, Horn, Črešnar 2024). Nabor metod so razširile raziskave starejšeželeznodobnih grobišč na Pezdirčevi njivi v Podzemlju (Prijatelj, Grčman 2025; Prijatelj, Turniški, Grčman 2025) in Habakuku pod Poštelo (Prijatelj et al. 2025), kjer so bile v raziskave gomil in širšega grobiščnega prostora vključene mikromorfologija ter geomorfološke, pedološke in palinološke analize. V nadaljevanju prispevka predstavljamo geoarheološko reinterpretacijo stratigrafije gomil dolenjske halštatske skupine in krajši povzetek že objavljene geoarheološke preiskave Pezdirčeve njive. Na podlagi dostopnih stratigrafskih podatkov oblikujemo hipoteze o različnih gradbenih materialih, načinih gradnje in umeščanju grobov v gomile na območju dolenjske halštatske skupine ter nato s pomočjo Pezdirčeve njive ponazorimo potencial geoarheoloških metod v primeru erodiranih gomil, ki so bile zaradi poljedelske rabe tal povsem izbrisane s površja.

STRATIGRAFSKI ZAPIS V GOMILAH DOLENJSKE HALŠTATSKE SKUPINE IN TEORETIČNI MODELI GRADNJE GOMIL

Grobne gomile predstavljajo eno ključnih značilnosti starejšeželeznodobne kulturne krajine dolenjske halštatske skupine (Gabrovec 1964–1965; 1966; 1987; 1999; 2008; Dular, Tecco Hvala 2007, 123–126; Teržan 2020). Zaradi dolge zgodovine raziskav, ki sega v drugo polovico 19. stoletja, sodijo med najpomembnejše arheološke vire za proučevanje starejše železne dobe v jugovzhodnoalpskem prostoru ter predstavljajo temelj številnih kronoloških in kulturnozgodovinskih interpretacij (Dular 2003; Teržan 2020). V pričujočem prispevku je v skladu s slovensko raziskovalno tradicijo (Dular 2003; Teržan 2020) v obravnavo vključeno tudi grobišče Budinjak (prim. Škoberne 2004).

Na podlagi sodobnih izkopavanj na 11 gomilnih grobiščih (*sl. 1*), dostopnih stratigrafskih podatkov in interpretacij izkopavalcev so v nadaljevanju predstavljeni trije teoretični modeli, ki predvidevajo različne načine gradnje gomil ter umeščanja grobov vanje (*sl. S1*[3]*; 2–8*). V analizo so vključena tista grobišča, katerih objave vsebujejo stratigrafsko dokumentacijo (profile, tlorise in/ali opise plasti), ki omogoča razpravo o različnih načinih gradnje. Vrsta in obseg dostopnih podatkov se med obravnavanimi najdišči močno razlikujeta. Pri nekaterih opisi gomil niso sistematično podprti s profili in opisi plasti (npr. Škoberne, Bugar 2017), pri drugih so zaradi uničenja gomil s poljedelsko rabo tal na voljo zgolj tlorisni prikazi prostorske razporeditve grobnih jam (npr. Križ 2019; Grahek 2025), spet tretja pa vključujejo tako izrise gomil v tlorisu in profilu kot tudi sistematične opise arheoloških plasti (npr. Guštin, Preložnik 2005; Udovč 2009; Tecco Hvala 2017; Tica 2022).

[3] *Slika S1* je na voljo kot dopolnilno gradivo na http://iza.zrc-sazu.si/pdf/razno/AV_78_Prijatelj_Grcman_Grahek_Suppl.pdf

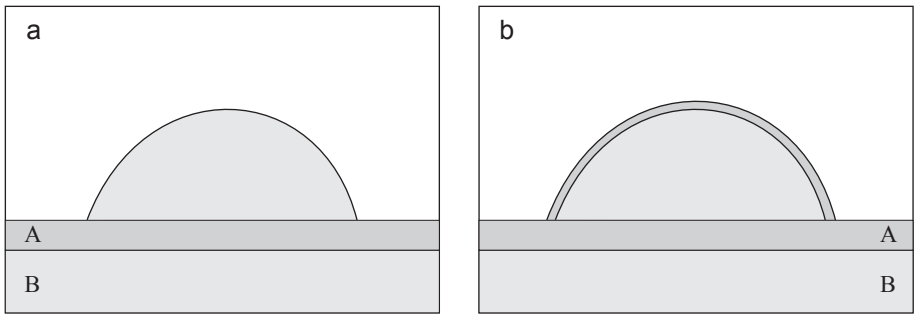


Sl. 1: Obravnavana halštatska grobišča z območja Dolenjske, Žumberaka in Bele krajine, kjer so bile gomile izkopane v skladu s sodobno metodologijo.
Fig. 1: Hallstatt-period cemeteries discussed in the paper from Dolenjska, Žumberak and Bela krajina, where tumuli were excavated using modern excavation methods.

Zaradi velikih razlik v ohranjenosti arheološkega zapisa ter vrsti in obsegu dostopnih podatkov je neizogibno, da se zanesljivost opredelitev tipov gomil med obravnavanimi grobišči razlikuje. Na *sliki S1* zato ločujemo med primeri, pri katerih dobro ohranjena stratigrafija in neposredno dokumentirani profili omogočajo razmeroma zanesljivo opredelitev, in tistimi, pri katerih interpretacije temeljijo na več domnevah in so zato bližje delovnim hipotezam. Prav tako je v primeru večfaznih gomil tipa 2 in 3 jasno označeno, ali je bil tip gomile interpretiran že s strani izkopavalcev in avtorjev predhodnih objav (*sl. S1*).

Prvi model (*sl. S1; 2*) ponazarja najenostavnejšo obliko gradnje, pri kateri je bilo za gomilni plašč uporabljeno zgolj eno nasutje. Upoštevajoč klasifikacijo gomil glede na število grobov (Teržan 2020, 373) je bil takšen način gradnje uporabljen predvsem za manjše gomile, na primer gomili 2 in 3 na Dolgih njivah pri Beli cerkvi z enim grobom (Mason 2005, 123–124; Mason, Mlekuž 2016, 111–113, sl. 10; Armit et al. 2023, 404–406, sl. 3), gomili 21 in 36 na Budinjaku z enim grobom (Škoberne 1999, 21–24, sl. 7–8), gomilo 16 na Grmadi pri Molniku z dvema grobovoma (Tecco Hvala 2017, 45–46, sl. 41) in gomilo na Grofovih njivah pri Drnovem s petimi grobovi (Pavlovič 2014, 493, sl. 28.3; Tica 2022, 22–24, sl. 20), morda pa tudi za žgane grobove 1, 5[4] in 6 na Rojah pri Molniku (Puš 1984, 139–144, sl. 1–5; Tecco Hvala 2017, 82). Enkratno nasutje je bilo morda arheološko dokumentirano tudi v srednje velikih gomilah, kot na primer v gomili 1 v Pleški hosti pri Molniku s 14 grobovi (Tecco Hvala 2017, 67–69, sl. 63–65) in gomili v

[4] Tecco Hvala (2017, 82) zapiše, da bi lahko v primeru vseh treh grobov šlo za manjše gomilice, vendar v Puševi objavi (1984, sl. 2) kopastega nasutja nad grobom 5 ni videti.



Sl. 2: Gradnja gomil tipa 1: **a** – plašč gomile tvori nasutje gradiva horizonta B; **b** – s poodložitvenimi pedogenimi procesi se na površini gomile oblikuje horizont A.
Fig. 2: Construction of Type 1 tumuli: **a** – mound fill constructed from material derived from the B horizon; **b** – formation of an A horizon on the mound surface through post-depositional pedogenic processes.

Mačkovcu pri Novem mestu[5] s 13 grobovi (Udovč 2009, 10; glej tudi *sl. S1*).[6]

Za naštete gomile je bil značilen žgan, skeletni ali biritualen pokop (*sl. S1*), najstarejši primerki takšnih gomil na Budinjaku in Molniku pa so datirani na sam začetek starejše železne dobe, (najpozneje) v začetek 8. st. pr. n. št. ali v čas stopnje Podzemelj (Škoberne, Bugar 2017, 34; Škoberne 2004, 140–144, prim. 20–21; Škvor Jernejčič 2017[7]). Po podatkih izkopavalcev so se grobovi pojavljali (delno) vkopani v tla ali matično kamninsko osnovo pod gomilnim nasutjem (npr. Puš, 1984, sl. 1–5; Škoberne 1999, 23; Tecco Hvala 2017, 68–78; Tica 2022, 22), na tleh pod gomilo (npr. Tecco Hvala 2017, 46) ali na različnih globinah znotraj gomilnega plašča (npr. Škoberne 1999, 23–24; Udovč 2009, 10, sl. 9). V redkih primerih so se grobne jame prekrivale (npr. Udovč 2009, sl. 9; Tecco Hvala 2017, sl. 65; Tica 2022, sl. 20). Na podlagi opisanih stratigrafskih odnosov med grobovi in gomilnim nasutjem izkopavalci sklepajo, da so bile nekatere gomile tipa 1, na primer gomila 21 na Budinjaku (Škoberne 1999, 23, sl. 6), naknadno nasute čez grobove, ki so bili vkopani v horizont B tal pod gomilo. V primeru drugih, na primer gomile 36 na Budinjaku (Škoberne 1999, 23–24, sl. 6, 8), so bile gomile najprej nasute na nekdanjo hodno površino, nakar so bili v gomilni plašč vkopani grobovi. V primeru tretjih pa je šlo za kombinacijo prvega in drugega scenarija: v nekdanja tla so bili najprej vkopani grobovi, sledilo je nasutje gomile in nato vkopi mlajših grobov v gomilni plašč (npr. Udovč 2009, 10, sl. 9).

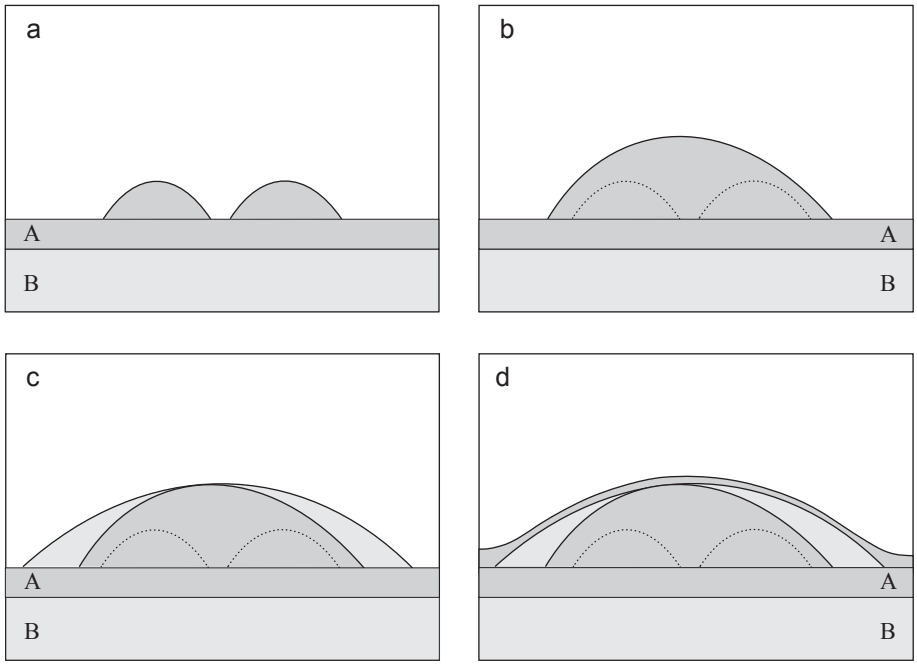
Drugi teoretični model (*sl. 3*) predvideva obstoj ene ali več manjših gomil z žganimi grobovi v nasutju, ki jih je nato v določenem trenutku prekrila večja gomila. Plašč slednje je tvorilo eno ali več nasutij, v katere se je nadaljevalo vkopavanje ali žganih in skeletnih grobov ali izključno skeletnih grobov (*sl. S1*). Opisani tip gomile bi lahko morda povezali z več manjšimi gomilami na Budinjaku, in sicer z gomilo 6 (Škoberne, Bugar 2017, 90, sl. 9.5) in 51 s štirimi grobovi (Škoberne 1999, 25–26, sl. 12) ter gomilo 7 s šestimi grobovi (Škoberne, Bugar 2017, 103–112, sl. 11.7). Morda je na takšen način nastala tudi gomila 17 na Grmadi pri Molniku z 10 grobovi (Škvor Jernejčič 2017, 93; Tecco Hvala 2017, 48–60, 82, sl. 44–45, 83). Gomile tipa 2 so bile prepoznane tudi med velikimi gomilami z več kot 40 pokopi. Med slednjimi je stratigrafsko najbolje dokumentirana gomila I na Hribu v Metliki (Križ 1988; 1990a; 1990b; Grahek 2004; 2014a; 2026[8]), na podlagi določenih podobnosti z gomilo I pa bi lahko morda predvidevali, da sta na podoben način nastali tudi gomili VI in 13 na Prelogah pri Magdalenski gori (prim. Hencken 1978, 41–51; Tecco Hvala, Dular, Kocuvan 2004, 98–110; Tecco

[5] Za razpravo o stratigrafiji in številu nasutij v gomili v Mačkovcu glej Gradbeni materiali in *sl. S1*.

[6] V primeru srednje velikih gomil, kakršni sta gomila 1 v Pleški hosti in gomila v Mačkovcu, je treba upoštevati tudi možnost, da večkratna nasutja z enakim gradivom makrostratigrafsko niso bila razpoznana (glej npr. Tecco Hvala 2017, 67).

[7] Škvor Jernejčičeva v uvodu omenja Puševo razlago o markacijski funkciji grobov iz Roj v prostoru, ki je sicer značilna za gomilne pokope, v zaključku pa vse obravnavane grobove opredeli kot plane (prim. str. 89 in 108).

[8] Na tem mestu primarno objavo dopolnjujemo s podatkovnim dodatkom, ki vključuje posamezne prej nepoznane in zato neobjavljene ali manjkajoče najdbe, ki pa bistveno ne vplivajo na kulturno-kronološko opredelitev posameznih pokopov v gomili.



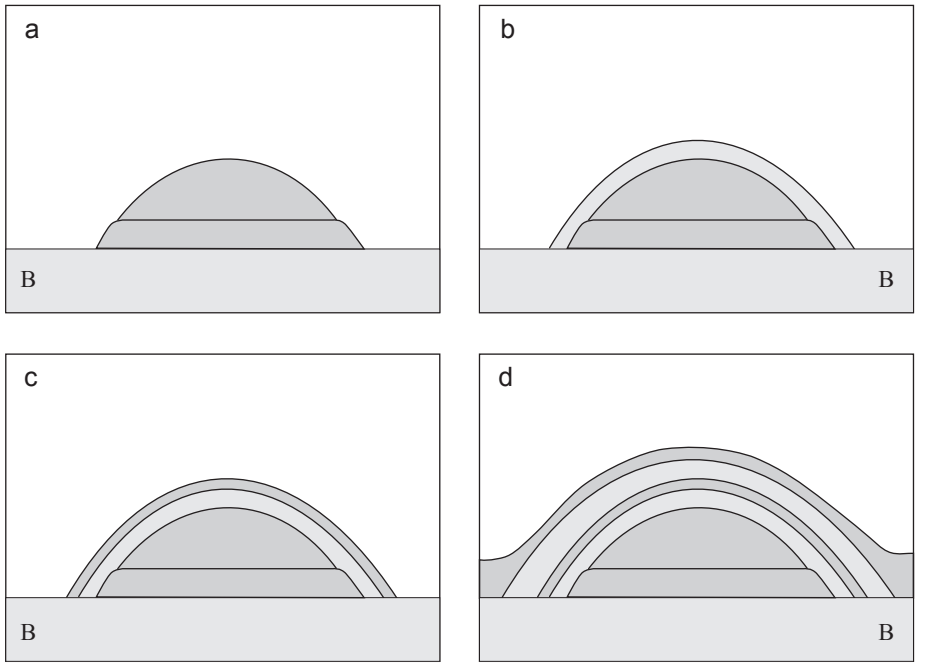
Sl. 3: Gradnja gomil tipa 2: **a** – nasutje manjših gomilic z gradivom horizonta A; v gomilice so integrirani žgani grobovi; **b** – nasutje večje gomile preko manjših gomilic; **c** – povečanje velike gomile z drugim nasutjem, za katerega je rabljeno gradivo horizonta B; **d** – s poodložitvenimi pedogenimi procesi se na površini gomile oblikuje horizont A. Teoretični primer temelji na stratigrafiji gomile I na Hribu v Metliki (Grahek 2004, pril. 1–4).
Fig. 3: Construction of Type 2 tumuli: **a** – construction of smaller burial mounds using material derived from the A horizon, with cremation graves incorporated into the smaller mounds; **b** – construction of a larger burial mound over the smaller mounds; **c** – enlargement of the large mound with a second fill consisting of material derived from the B horizon; **d** – formation of an A horizon on the mound surface through post-depositional pedogenic processes. The theoretical model is based on the stratigraphy of Tumulus I at Hrib in Metlika (Grahek 2004, Pls. 1–4).

Hvala 2012, 344–346; sl. 13, 16). Podoben način izgradnje je Šribar predvideval tudi za gomilo sv. Helene v Zemlju (Grahek 2014b, 234, sl. 7).

Tretji teoretični model (*sl. 4*) predvideva, podobno kot drugi, večfazno večanje gomil, vendar z nekaj pomembnimi razlikami. Medtem ko je v primeru gomil tipa 2 večja gomila prekrila eno ali več manjših gomil z žarnimi grobovi, kar je lahko privedlo do nepravilne ali razpotegnjene oblike večje gomile (prim. Grahek 2004, sl. 11; Tecco Hvala 2012, 345, sl. 16), pa so se gomile tipa 3 širile koncentrično navzven. Najstarejši plašč gomil tega tipa je običajno prekrival ali centralni skeletni grob, pogosto z večjo in bolj kompleksno grobno konstrukcijo, na primer leseno ali kamnito grobno kamro (*sl. S1*), ali namenoma prazen osrednji del. V okviru tega tipa ločimo dve varianti gomil, tipa 3a in 3b, ki se razlikujeta glede na razporeditve grobov glede na centralni grob ali središče gomile, zelo verjetno pa tudi v kronološkem in prostorskem odnosu med grobovi in nasutji.

Razporeditev grobov je bila v primeru gomil tipa 3a bistveno bolj strogo normirana kot v primeru gomil tipa 1 in 2, saj so bili skeletni grobovi več generacij pokojnih razporejeni tangencialno in v koncentričnih krogih po obodu gomile. Opisani način gradnje in organizacije grobov v gomilah tipa 3a je bil uporabljen tako za manjše, t. i. družinske gomile, na primer gomilo 1[9] na Dolgih njivah pri Beli cerkvi s šestimi grobovi (Mason 2005, 123–124; Mason, Mlekuž 2016, 111–113, sl. 10; Armit et al. 2023, 404–406, sl. 3), gomilo 9 v Sajevcah pri Kostanjevici s štirimi grobovi (Guštin, Preložnik 2005, 129–130, sl. 11), gomilo 10 v Velikih Malencah s petimi grobovi (Guštin 1996, 119, sl. 3), gomilo 139 na Budinjaku s sedmimi grobovi (Škoberne 1999, 43–107, sl. 26–27; Škoberne, Bugar 2017, 67–72) in srednje veliko gomilo 5 v Stični s 27 grobovi (Gabrovec et al. 2006, pril. 4; Kruh 2008, 69–71), kot tudi za monumentalne rodovne gomile, med katerimi je stratigrafsko najbolje dokumentirana velika gomila 48 v Grižah pri Stični s 152 grobovi

[9] Gre za prvo gomilo dolenjske halštatske skupine, pri kateri so analize DNK potrdile sorodstvene vezi med pokojniki (Armit et al. 2023).



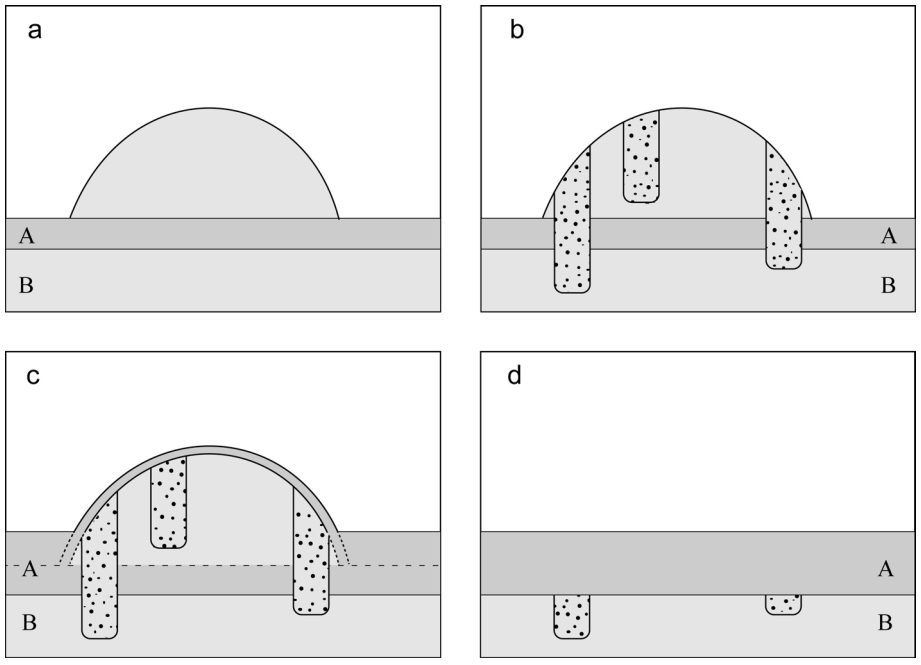
Sl. 4: Gradnja gomil tipa 3: **a** – predpriprava površine za gradnjo gomile: namenska odstranitev horizonta A v neposredni bližini najstarejšega nasutja. Gradnja prve gomile preko centralnega groba z režnji ruše; **b** – povečanje gomile z gradivom horizonta B; **c** – sedimentacijski hiatus; s poodložitvenimi pedogenimi procesi se na površini gomile oblikuje horizont A; **d** – cikel se ponovi. Povečanje gomile z gradivom horizonta B. S poodložitvenimi pedogenimi procesi se na površini gomile oblikuje horizont A. Teoretični primer temelji na poenostavljeni stratigrafiji velike gomile 48 v Stični (Gabrovec et al. 2006, pril. 1–2; glej tudi Teržan 2024, sl. 5–8).
Fig. 4: Construction of Type 3 tumuli: **a** – preparation of the surface for mound construction through the deliberate removal of the A horizon in the immediate vicinity of the earliest mound. Construction of the first burial mound over the central grave using sod blocks; **b** – enlargement of the mound using material derived from the B horizon; **c** – sedimentation hiatus during which an A horizon forms on the mound surface through post-depositional pedogenic processes; **d** – the cycle is repeated. Enlargement of the mound using material derived from the B horizon. An A horizon forms on the mound surface through post-depositional pedogenic processes. The theoretical example is based on a simplified version of the stratigraphy of the large Tumulus 48 at Stična (Gabrovec et al. 2006, Pls. 1–2; see also Teržan 2024, Figs. 5–8).

(Gabrovec et al. 2006, pril. 2; Gabrovec, Teržan 2008, 39, 40–43, 46; Teržan 2024, 130–132, sl. 5–8).

V naštetih primerih so bili v gomilah dokumentirani ali izključno skeletni ali prevladujoči skeletni grobovi (*sl. S1*). Žgani grobovi so bili prisotni predvsem znotraj velikih in srednje velikih gomil tipa 3, in sicer kot starejši, poznobronastodobni plani žgani grobovi, ki jih je v določenem trenutku prekrila rastoča gomila, in/ali redkeje kot halštatski žgani grobovi, integrirani v gomilo (npr. Gabrovec 2008, 40–41; Kruh 2008, 71–72). Tangencialno razporejeni skeletni grobovi so bili pogosto (delno) vkopani v tla ali položeni na tla in prekriti z manjšimi nasutji ob obodu gomile. Ko se je krog grobov sklenil, je bila gomila razširjena in povišana z novim nasutjem. Šele v najmlajši fazi se je pokop običajno spremenil v toliko, da se je pokopavalo le še v različna nasutja gomile, torej nad nivo nekdanje hodne površine (npr. Guštin 1996, sl. 3; Guštin, Preložnik 2005, sl. 11; Gabrovec et al. 2006, pril. 2; Gabrovec 2008, 39, 40–43, 46, sl. 19–20).

V primeru variante gomil tipa 3b (*sl. S1)* se grobovi dostikrat prekrivajo, brez da bi bili tangencialno in koncentrično nanizani po obodu gomile, zato ne ustvarjajo vtisa normirane prostorske organizacije. Takšno strukturiranje gomil najdemo predvsem med srednje velikimi gomilami, kot v primeru gomile 13 na Grmadi pri Molniku (Tecco Hvala 2017, 34–44, 82, sl. 26–27, 83), gomil XVI in XVIII na Kapiteljski njivi (Križ 2019, 283–284, 286–287), morda pa tudi v primeru gomile v Mačkovcu pri Novem mestu (Udovč 2009, 10).[10] Številni avtorji sicer opozarjajo na razporeditev grobov v gomilah tega tipa (npr. Križ 2019, 137–138; Teržan 2020, 370), vendar ne razpravljajo o implikacijah za

[10] Glej op. 4.



Sl. 5: Teoretični model, razvit za gomile na Kapiteljski njivi (prirejeno po Križ 2019, sl. 9): **a** – nasutje gomile; **b** – vkopi grobov v gomilo. Nekateri vkopi grobov sežejo v tla pod gomilo; **c** – s poodložitvenimi pedogenimi procesi se na površini gomile oblikuje horizont A. Pojav poljedelskih površin na območju gomile; **d** – postopno popolno uničenje gomile z oranjem. V stratigrafskem zapisu so ohranjena le dna tistih grobnih jam, ki sežejo v horizont B.
Fig. 5: Theoretical model developed for the tumuli at Kapiteljska njiva (adapted from Križ 2019, Fig. 9): **a** – construction of the mound; **b** – grave pits cut into the mound. Some grave pits extend into the soil beneath the mound; **c** – an A horizon forms on the mound surface through post-depositional pedogenic processes. The beginning of agricultural land use in the wider mound area; **d** – gradual erosion and eventual complete destruction of the mound through ploughing. Only the bases of those grave pits extending into the B horizon survive in the stratigraphic record.

način gradnje gomil. V nasprotju s tipom 3a, pri katerem naj bi bil novi plašč nasut potem, ko se je pokopavanje na obodu gomile sklenilo, bi lahko pri tipu 3b na podlagi razporeditve grobov in njihovega stratigrafskega položaja morda predvidevali, da je bila gomila najprej razširjena z novim nasutjem, temu pa je sledilo vkopavanje grobov v njen plašč, morda brez nekih posebnih oznak, ki bi nakazovale njihove lokacije v gomili. Gomila 13 v Pleški hosti pri Molniku je med naštetimi primeri še posebej nenavadna, saj se je od 14, sicer v plasteh težko sledljivih grobov, prekrivalo kar devet. To bi morda lahko nakazovalo, da se je v nekaterih primerih pokopavanje večjega števila pokojnih celo namenoma izvajalo v istem delu gomile.

Glede na tu predstavljene načine gradnje gomil in umeščanja grobov vanje komentiramo še teoretični model (*sl. 5*), razvit posebej za grobišče na Kapiteljski njivi v Novem mestu (Križ 2000, 44; 2019, 28–31, 36, sl. 9). Model predvideva tri temeljne procese, ki naj bi vodili do obstoječega stratigrafskega zapisa na najdišču: nasutje gomil, vkop grobov v gomile in uničenje gomil z moderno poljedelsko rabo.

Kapiteljska njiva (*sl. 1; S1*) je kot obsežno multiperiodno grobišče, na katerem je bilo v več kot tri desetletja potekajočih izkopavanjih dokumentirano 71 gomil[11] in več kot 300 žganih grobov (npr. Knez 1993; Križ 1997; 2000; 2013; 2019; Bricelj 2003), poleg Budinjaka (Škoberne 1999; 2004; Škoberne, Bugar 2017) brez dvoma tisto najdišče, ki bi lahko pomagalo razjasniti spremembe v pogrebnih običajih na prehodu iz kulture žarnih grobišč v halštatsko obdobje (prim. Teržan 2020, 368–373). Dolgoletne terenske raziskave so bile primarno zaščitne narave in so potekale pred uveljavitvijo sodobnih geoarheoloških metod. Zato interpretativni model temelji predvsem na razpoložljivih arheoloških podatkih, pri čemer žgani grobovi, ki so bili izkopani v okviru posameznih gomil, a opredeljeni kot del planega grobišča iz časa poznobronastodobne kulture žarnih grobišč, niso

[11] Poleg 69 gomil, ki jih obravnava Križ (2019), sta na tem območju znani še gomili A in B, izkopani leta 1894 in objavljeni pri Knezu (1993), vendar njuna natančna lokacija ostaja nejasna (prim. Knez 1993, sl. 25; Križ 2019, pril. 1).

bili vključeni v razpravo o razvoju tamkajšnjih gomil (Križ 2019, prim. npr. 257, 273, 287, 316, 337 itd.). Menimo, da bi lahko njihova ponovna obravnava in geoarheološka preiskava grobišča pomembno dopolnili interpretacijo razvoja najdišča.

Model gradnje gomil in umeščanja grobov vanje, ki ga predstavlja B. Križ (2019, 28–34), predstavlja eno izmed možnih interpretacij in je vsekakor vreden nadaljnje presoje. Scenarij, ki ga predvideva, je bil namreč stratigrafsko dokumentiran za majhne gomile tipa 1 na Budinjaku (prim. Škoberne 1999, 23–24, sl. 6, 8), zato je povsem mogoče, da so na podoben način nastale tudi nekatere manjše gomile na Kapiteljski njivi. Po drugi strani velik razpon dimenzij gomil na najdišču, razlike v tipu, številu, prostorski strukturiranosti in dataciji grobov znotraj posameznih gomil (prim. Križ 2019, 252–343) ter vzporednice z Budinjakom nakazujejo možnost, da so bili tudi na Kapiteljski njivi zastopani različni načini gradnje in strukturiranja gomil (*sl. 2–4;* prim. *sl. S1*).

Ker gre na Kapiteljski njivi za razorane gomile, ki so bile popolnoma izbrisane s površja, lahko njihov potek danes rekonstruiramo predvsem na podlagi razporeditve spodnjih delov grobnih jam, ohranjenih v mineralnem horizontu B. Takšno stanje pomembno omejuje možnosti stratigrafske interpretacije. Na najdiščih, kjer gomilni plašči ter stratigrafska zveza med nasutji in grobnimi jamami niso več ohranjeni, je praviloma težko zanesljivo določiti število gradbenih faz ali kronološko razmerje med gomilnim nasutjem in posameznimi grobovi, tudi v primeru uporabe geoarheoloških metod (prim. Križ 2019, sl. 9; Prijatelj, Turniški, Grčman 2025).

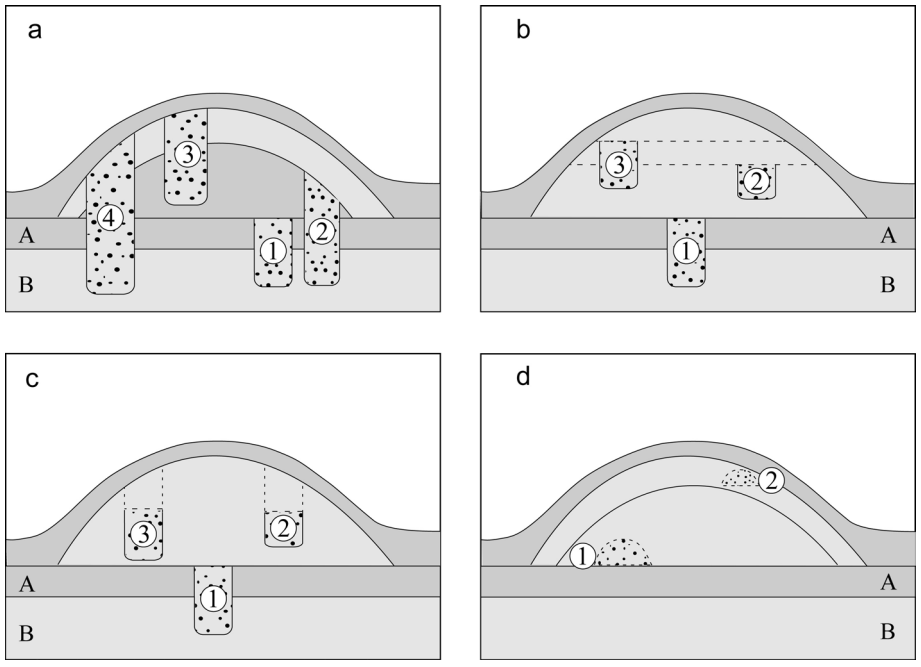
Strinjamo se s Križevim poudarkom, da dosežene globine grobnih jam same po sebi ne morejo služiti kot kazalnik relativne starosti posamičnih grobov (Križ 2019, 36), in ga v kontekstu obravnavane problematike dopolnjujemo s premislekom o značilnostih stratigrafije grobov v gomilah. V skladu z načeli arheološke stratigrafije (Harris 1979; 1989) pri določanju relativne starosti vkopov ni bistvena primerjava globin, ki jih dosežejo dna posamičnih vkopov, temveč stratigrafski odnos med nivoji, s katerih so bile grobne jame vkopane v spodaj ležeče plasti (*sl. 6:* a). Nivo vkopov grobnih jam predstavlja v okviru preučevanja gomil svojevrsten stratigrafski problem, saj tudi v primeru sodobnih izkopavanj pogosto ni jasno razpoznaven (npr. Škoberne 1999, 29; Grahek 2025, 24). Grobne jame zato v dokumentiranih profilih pogosto navidezno "plavajo" sredi gomilnih plasti (npr. Guštin, Preložnik 2005, sl. 11: C; Tecco Hvala 2017, sl. 27: B, 28), kar otežuje njihovo stratigrafsko interpretacijo. Takšen zapis je mogoče pojasniti s tremi hipotetičnimi scenariji.

Po prvem scenariju vrhnji nivo grobne jame predstavlja prvotni nivo vkopa v gomilni plašč. To pomeni, da površina, s katere je bil grob dejansko vkopan, pri dokumentiranju ni bila prepoznana kot horizontalna interfacija (*sl. 6:* b). Do takšne situacije bi lahko prišlo, če bi bil gomilni plašč nasut do določenega nivoja, sledil bi vkop groba in nato ponovno nasutje gomile z istim materialom. Po drugem scenariju bi nivo vkopa sovpadal z zgornjo mejo ene od plasti v gomili, zgornji del zasutja grobne jame pa naj bi se zaradi poodložitvenih, predvsem pedogenih, procesov sčasoma homogeniziral z okoliškim gradivom, še zlasti v zgornjem delu gomile (*sl. 6:* c). Po tretjem scenariju v primeru "plavajočih grobov" ne bi šlo za vkope, temveč za nasipavanje zemljine preko pokojnega, položenega na določeno površino. Tudi v tem primeru površina, na kateri je bil pokojnik zasut, pri dokumentiranju ne bi bila prepoznana kot horizontalna interfacija (*sl. 6:* d; *7*).

Pri razlikovanju med vkopanimi in nasutimi grobovi nam je lahko v pomoč geometrija grobnih struktur. Vkopane grobne jame imajo praviloma pravokotno ali konkavno obliko z zoženjem proti dnu, medtem ko imajo nasuti grobovi konveksno obliko z zoženjem proti vrhu. Upoštevati je treba še tretji tip groba, ki je delno vkopan in delno nasut ter združuje značilnosti obeh opisanih tipov (*sl. 7*). V primeru nasutih ter delno vkopanih in delno nasutih grobov gre za tipa pokopa, kakršna sta bila prepoznana v nekaterih gomilah tipa 3a (*sl. 7*; npr. Guštin, Preložnik 2005, 123, sl. 11; Gabrovec 2008, 13–17; Kruh 2008, 71).

Obravnavani primeri (*sl. 1; S1*) ponazarjajo pomen natančnega dokumentiranja stratigrafskih odnosov. Rekonstrukcija različnih tipov gradnje gomil (*sl. 2–4*) in načinov vključevanja grobov vanje (*sl. 6–7*) temelji na geometriji nasutij, grobov in njihovih medsebojnih stratigrafskih odnosih. Tudi pri številnih gomilah, raziskanih s sodobno metodologijo, omejujejo interpretacijo poodložitveni pedogeni procesi, delno ali popolno uničenje gomil in ponekod tudi selektivna objava stratigrafskih podatkov.[12] Zanesljivost interpretacij bi

[12] Med objavljenimi gomilami z Budinjaka (Škoberne 1999; Škoberne, Bugar 2017) je stratigrafija prikazana zgolj za gomilo 139 (Škoberne 1999, sl. 9).



Sl. 6: Stratigrafija grobov v gomilah: **a** – stratigrafija v gomili, vključno z vkopi in polnili grobnih jam, je dobro ohranjena. Vkopom grobnih jam je mogoče slediti vse do površin, s katerih so bile vkopane v plasti spodaj; **b** – "plavajoči" grobovi v gomilah (scenarij 1): površini, s katerih sta bila grobova 2 in 3 vkopana v plašč gomile, s prostim očesom nista več razpoznavni; **c** – "plavajoči" grobovi v gomilah (scenarij 2): pedogeni procesi postopoma homogenizirajo in zabrisujejo stratigrafski zapis v gomili vertikalno navzdol, zato so vkopi in polnila grobnih jam 2 in 3 ohranjeni le še v njunem spodnjem delu znotraj gomilnega plašča; **d** – "plavajoči" grobovi v gomilah (scenarij 3): površina, na katero je bil grob 2 nasut, predno je bil prekrit z gomilnim plaščem, ni več vidna.

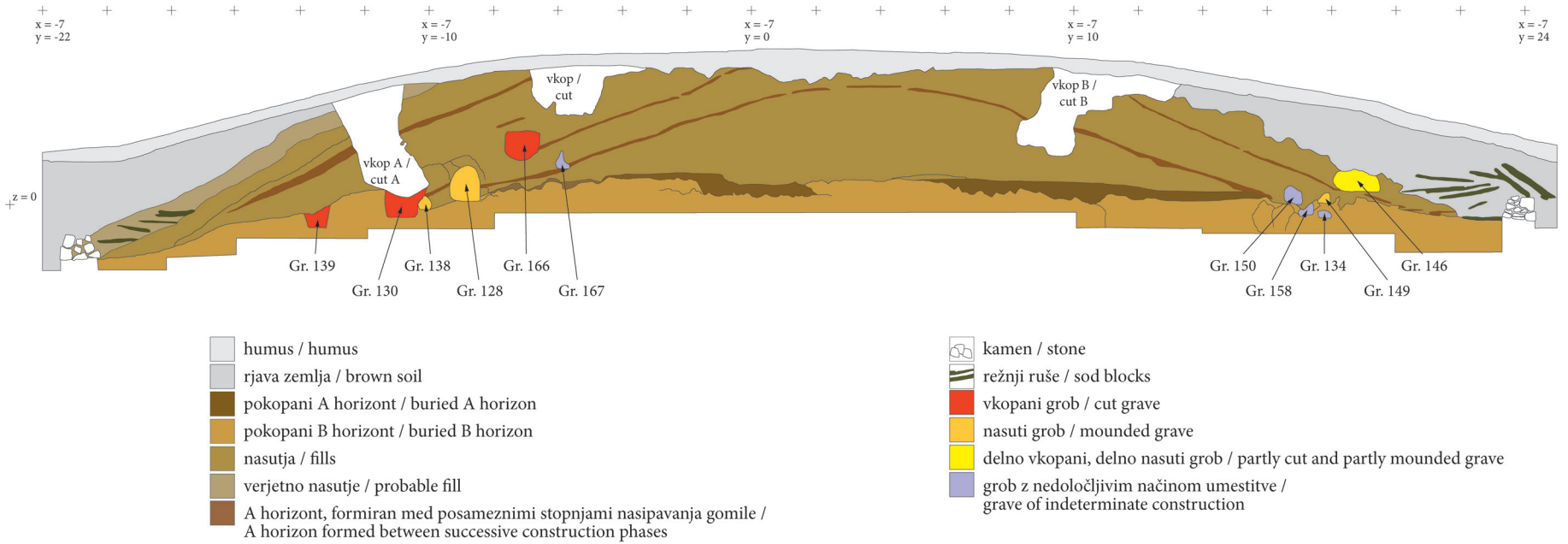
Fig. 6: Stratigraphy of graves in tumuli: **a** – the stratigraphy within the mound, including grave cuts and grave-pit fills, is well preserved. The grave cuts can be traced up to the surfaces from which the pits were cut into the underlying layers; **b** – stratigraphically 'floating' graves in tumuli (scenario 1): the surfaces from which Graves 2 and 3 were cut into the mound fill are no longer macroscopically distinguishable; **c** – stratigraphically 'floating' graves in tumuli (scenario 2): pedogenic processes progressively homogenise and obscure the stratigraphic record downwards from the mound surface, so that the cuts and fills of grave pits 2 and 3 are preserved only in their lower parts; **d** – stratigraphically 'floating' graves in tumuli (scenario 3): Grave 2 was placed on the mound surface and covered by heaped soil, but the surface on which it was placed is no longer macroscopically distinguishable.

bilo mogoče v prihodnje izboljšati z vključitvijo geoarheoloških metod v raziskave gomil.

Kljub navedenim omejitvam je na podlagi makroskopskih stratigrafskih opažanj in kronologije mogoče podati nekaj splošnih ugotovitev. Medtem ko so bile gomile tipa 1 dokumentirane predvsem med manjšimi gomilami, so bile gomile tipa 2 in 3 prepoznane med majhnimi, srednje velikimi in velikimi gomilami (*sl. S1*). To kaže, da omenjena načina gradnje (*sl. 3–4*) verjetno nista bila pogojena z velikostjo gomile in z njo povezanimi konstrukcijskimi odločitvami, temveč predvsem kulturnimi konvencijami in pogrebnimi običaji, ki so se na ozemlju dolenjske halštatske skupine spreminjali skozi čas. V nasprotju s tipom 1 se druga dva tipa kažeta tudi kot kronološko bolj občutljiva.

Najstarejša faza gomil tipa 2 je bila v monumentalni gomili I na Hribu v Metliki datirana že v 10. st. pr. n. št. ali čas zgodnje stopnje Ha B[13] (Grahek 2004; 2014a), v primeru majhnih gomil na Budinjaku pa najkasneje v začetek 8. st. pr. n. št. oziroma na prehod stopenj Ha B2–3 in Ha C0 (Škoberne, Bugar 2017, 34; Škoberne 2004, 140–144, 20–21; prim. Teržan 2008, sl. 42). To kaže, da je bil ta način gradnje v uporabi že ob prehodu iz pozne bronaste v starejšo železno dobo. Monumentalne gomile tega tipa na Magdalenski gori, na primer gomile VI, VII in 13 na Prelogah (prim. Tecco Hvala 2012, 53–54, sl. 16), kažejo, da se je takšen način pokopavanja v skupnostih z izrazitejšim

[13] V prispevku sledimo kronološki shemi Teržan 2008 in absolutnim datacijam po Teržan, Črešnar (ur.) 2014.



Sl. 7: Velika gomila 48 iz Stične, *profil E* (po Gabrovec et al. 2006, pril. 2).
Fig. 7: Large Tumulus 48 at Stična, *section E* (after Gabrovec et al. 2006, Pl. 2).

deležem žganih pokopov ohranil tudi v razvitem halštatskem obdobju (Tecco Hvala 2012, 79; prim. Grahek 2025, 104–106, 191, t. 11: A). [14]

Nasprotno pa so gomile tipa 3a s kompleksnimi grobnimi strukturami centralnih grobov, prevladujočimi skeletnimi grobovi in strogo normirano razporeditvijo grobov po obodu gomile datirane predvsem v čas od Ha C1 ali stopnje Stične dalje (npr. Gabrovec 2008, 39, 40–43, 46; Gabrovec et al. 2006, pril. 3–4; Kruh 2008, 69–71; Križ 2019, 254–255, 258–260, 262–265) in kot take predstavljajo enega od značilnih tipov dolenjskih gomil razvitega halštatskega obdobja.

Poleg predstavljenih tipov je na območju dolenjske halštatske skupine mogoče pričakovati tudi druge načine gradnje in strukturiranja gomil. Verjeten primer predstavlja gomila III na Kapiteljski njivi, kjer skupino žganih grobov kulture žarnih grobišč v središču obkroža koncentričen niz skeletnih grobov, datiranih od stopnje Stična do stopnje negovskih čelad v času LT A (Križ 2019, 258–260; Teržan 2020, 369–370, sl. 3). Zaradi uničenega stratigrafskega zapisa ostaja odprto, ali gre za različico gomile tipa 3a, ki je prekrila plane žgane grobove, ali za prehodno obliko med tipoma 2 in 3, pri kateri so bili starejši žgani grobovi z lastnimi gomilicami vključeni v mlajšo gomilno konstrukcijo.

GRADBENI MATERIALI

V doslej opravljenih raziskavah gomil dolenjske halštatske skupine so bili gradbeni materiali opredeljeni zgolj na podlagi makroskopskih opažanj med izkopavanji. V večini objav so bile posamezne plasti v gomilnem plašču opisane na podlagi barvnih razlik (*sl. S1*), ponekod pa tudi njihove teksture in konsistence gradiva (npr. Udovč 2009; Tecco Hvala 2017). Z izjemo Pezdirčeve njive (Prijatelj, Turniški, Grčman 2025; glej tudi v nadaljevanju) doslej na nobenem najdišču dolenjske halštatske skupine niso bile izvedene sistematične fizikalno-kemijske in mikromorfološke analize gomilnega gradiva. Ker se razprava o gradbenih materialih večinoma opira na makroskopsko dokumentirane stratigrafske podatke (*sl. S1*), ostajajo tu predstavljene geoarheološke interpretacije hipotetične.

Makroskopski stratigrafski opisi kažejo, da je bila pri številnih gomilah uporabljena ena sama vrsta lokalnega, nevezanega gradiva (*sl. S1*). Takšen način gradnje je značilen predvsem za manjše in srednje velike gomile tipov 1 in 2, na primer gomilo 16 na Grmadi pri Molniku (Tecco Hvala 2017, 45–47, 82, sl. 41), gomilo 1 v Pleški hosti pri Molniku (Tecco Hvala 2017, 67–78, sl. 63–65), gomilo v Mačkovcu pri Novem mestu (Udovč 2009, 10–11, sl. 9–13), gomilo na Grofovih njivah pri Drnovem (Pavlovič 2014, 493, sl. 28.3; Tica 2022, 22–24, sl. 20, 22–24) in verjetno tudi več manjših gomil na Budinjaku.[15]

Kot primer interpretativnih omejitev makroskopskih opisov plasti izpostavljamo gomilo v Mačkovcu. V njenem plašču sta bili med recentno rušo (SE 001) in sterilno geološko osnovo (SE 006) z apnenčevimi kamni (SE 005) dokumentirani dve plasti: takoj pod rušo čvrsta rjava meljasta ilovica (SE 002), debela 0,36–0,50 m, brez arheoloških najdb, in spodnja, čvrsta, mastna rumenorjava ilovica (SE 004), debela 0,35–0,50 m, v kateri so bili odkriti grobovi in fragmenti keramike. Izkopavalci so plast SE 004 interpretirali kot gomilni plašč, zgornjo SE 002 pa kot njegov vrhnji del (Udovč 2009, 10–11, sl. 12, 13).

Na podlagi makroskopskih podatkov ni mogoče zanesljivo presoditi, ali plasti SE 004 in SE 002 predstavljata dve ločeni gradbeni fazi ali pa je zgornja plast rezultat poznejšega preoblikovanja prvotnega gomilnega nasutja. Kot del površinskega reliefa so gomile podvržene različnim pedosedimentarnim procesom, ki lahko odvzemajo ali dodajo gradivo na površino gomil in hkrati z vertikalno usmerjenimi pedogenimi procesi spreminjajo lastnosti gradiva v samih gomilah, še zlasti v njihovem vrhnjem delu (prim. Hejcman et al. 2013; Kabała et al. 2019). Medtem ko poljedelska raba povzroča erozijo in zniževanje gomil, lahko koluvialni procesi ali dolgotrajna travniška raba prispevajo tudi k nastanku zadebeljenega kumulativnega horizonta A v vrhnjem delu plašča.

[14] Ker v številnih primerih, zlasti pri starejših izkopavanjih, ni mogoče zanesljivo ugotoviti, ali so bili starejši žgani grobovi dejansko umeščeni v manjše gomile ali pa jih je poznejše nasutje zgolj prekrilo, bi bilo treba v obravnavo razvoja gomilnega prostora v prihodnje vključiti tudi geoarheološke metode. V primeru dobro ohranjenega arheološkega zapisa bi te namreč lahko pripomogle k razrešitvi enega od temeljnih problemov v študijah gomil.

[15] Škoberne (1999, 18–30) v razpravi o tipih pokopa na najdišču sicer v op. 46 specificira, da so bile gomile grajene iz dveh tipov zemljin: rumene zemljine brez skeleta (tj. brez delcev kamnin in mineralov, ki so večji od 2 mm) in mešane z ilovico ter rdeče zemljine (ilovice) s skeletom. Oba tipa zemljine sta bila dokumentirana v horizontih B na najdišču; vendar z izjemo gomile 139 Škoberne (1999, 43–44, sl. 27) ne prikaže stratigrafije, dokumentirane v posamičnih gomilah.

Na podlagi razpoložljivih podatkov postavljamo hipotezo, da plast SE 002 ne predstavlja drugega gomilnega nasutja, temveč s pedogenimi in sedimentacijskimi procesi preoblikovan vrhnji del prvotne gomile. Takšno razlago podpirajo lega gomile na razgibanem reliefu (Udovč 2009, 6, sl. 3, 6, 7), zgodovinsko izpričana travniška raba (Udovč 2009, sl. 4) ter difuzen prehod med recentno rušo (SE 001) in plastjo SE 002, v kateri je bil dokumentiran gost koreninski sistem (Udovč 2009, 10, sl. 12, 13). Če naša interpretacija drži, predstavlja gomila v Mačkovcu primer gomile, zgrajene iz enega tipa gradbenega materiala, katere zgornji del je bil po gradnji pomembno preoblikovan zaradi pedogenih in sedimentacijskih procesov. Ta primer hkrati opozarja, da makroskopsko določene plasti v gomili ne odražajo nujno različnih gradbenih faz, temveč lahko predstavljajo posledico poznejšega razvoja tal.

Naslednjo obliko uporabe gradbenih materialov zasledimo v gomilah, katerih makroskopski stratigrafski opisi kažejo uporabo dveh različnih tipov gradbenega materiala (*sl. S1*). Takšen pristop h gradnji je značilen predvsem za srednje velike in velike gomile tipov 2 in 3, med drugim za gomilo 13 na Grmadi pri Molniku (Škvor Jernejčič 2017, 91; Tecco Hvala 2017, 34–44, 82, sl. 26–27, 83), gomilo 48 v Stični (Gabrovec et al. 2006, pril. 1–2; Gabrovec 2008, 39, 40–43, 46; Teržan 2024, 130–132, sl. 5–8), gomilo 10 v Velikih Malencah (Guštin 1996, 119, sl. 3), gomilo 139 na Budinjaku (Škoberne 1999, 43–107, sl. 26–27; Škoberne, Bugar 2017, 67–72) in gomilo I na Hribu v Metliki (Križ 1988; 1990a; 1990b; Grahek 2004, 118–120, sl. 11, 13–15, pril. 1–4).

V več primerih makroskopski opisi kažejo izrazite razlike med temnejšimi, verjetno z organsko snovjo bogatejšimi plastmi in svetlejšimi, mineralnimi plastmi. Tako sta bila na primer za gomilo 10 v Velikih Malencah (Guštin 1996, 119, sl. 3) in veliko gomilo I na Hribu v Metliki (Grahek 2004, 118) opisana spodnje, temnejše in zgornje, svetlejše nasutje. Na podlagi teh opisov je mogoče domnevati, da je bilo pri začetnem nasutju uporabljeno gradivo nekdanjih humusno-akumulativnih horizontov A, medtem ko je bilo za poznejše povečanje gomile pridobljeno gradivo iz podpovršinskih mineralnih horizontov. Zaradi manjše vsebnosti organske snovi in večjega deleža glinenih mineralov ter železovih in aluminijevih oksidov bi bilo takšno gradivo pričakovano svetlejše oziroma rumenkasto do rdečkasto obarvano (prim. Guštin 1996, 119, sl. 3; Grahek 2004, 118). Če predlagana interpretacija o izvoru rabljenega gradiva drži, bi uporaba zemljin mineralnih horizontov lahko odražala tudi zavestno konstrukcijsko odločitev. Gradiva z večjim deležem gline imajo namreč boljše kohezijske lastnosti in lahko prispevajo k večji stabilnosti večjih zemljenih konstrukcij (prim. Papadopoulos, Bejko, Morris 2008; Gkouma, Karkanas, Iacovou 2021).

Posebno varianto gradnje z dvema vrstama gradiva zasledimo v veliki gomili 48 v Stični (Gabrovec et al. 2006, pril. 1–2; Gabrovec 2008, 39, 40–43, 46; Teržan 2024, 130–132, sl. 5–8). V *profilih E*[16] in *G* je bilo dokumentiranih vsaj šest zaporednih nasutij, opisanih kot rumenkasto sive plasti (Gabrovec et al. 2006, pril. 2),[17] ki najverjetneje predstavljajo uporabo sorodnega mineralnega gradiva skozi več gradbenih faz. Znotraj kamnitega venca so bile dokumentirane tudi horizontalno orientirane svetlo sive leče (*sl. 7*).[18]

Makroskopska dokumentacija sama po sebi ne omogoča zanesljive razlage teh struktur. Vendar pa njihova oblika in razporeditev spominjata na stratigrafijo gomile 28 na Pošteli pod Habakukom, kjer je mikromorfološka analiza pokazala, da podobno izmenjevanje sivih in rumenih plasti predstavlja zložene režnje ruše (Prijatelj et al. 2025). Zato je mogoče predlagati hipotezo, da je bila ruša uporabljena tudi v najmlajši fazi gomile 48 v Stični. Morda so bili režnji ruše znotraj kamnitega venca zloženi v manjši navpičen zidec, oziroma uporabljeni kot dodatna konstrukcijska opora, ki je preprečevala polzenje in posedanje gradiva v monumentalni gomili (*sl. 7*; prim. Borisov et al. 2019, 128, sl. 6).

Možnost uporabe ruše pri gradnji gomil dolenjske halštatske skupine doslej ni bila sistematično obravnavana. Na njeno morebitno prisotnost v veliki gomili 48 je na podlagi arhivskih risb in fotografij profilov iz let 1946 in 1962 ter primerjav s stratigrafijo skitskih kurganov opozorila Teržanova

[16] Ker so tako horizonti tal kot nekateri profili gomil označeni s črkami, uporabljamo za lažje razlikovanje med obema tipoma podatkov za arheološke profile ležeči zapis.

[17] Gabrovec (2008, 39, 40–43, 46) v opisu gomile 48 obravnava le štiri nasutja: najstarejšo gomilo, ki prekriva centralni grob 19–22, in tri poznejša nasutja. Po drugi strani je v *profilih E* in *G* jasno vidno večje število plasti v gomili. Pod rjavo plastjo lahko v južnem delu *profila E* in v *profilu G* naštejemo vsaj šest plasti v plašču gomile (prim. sl. 7; Gabrovec et al. 2006, pril. 2).

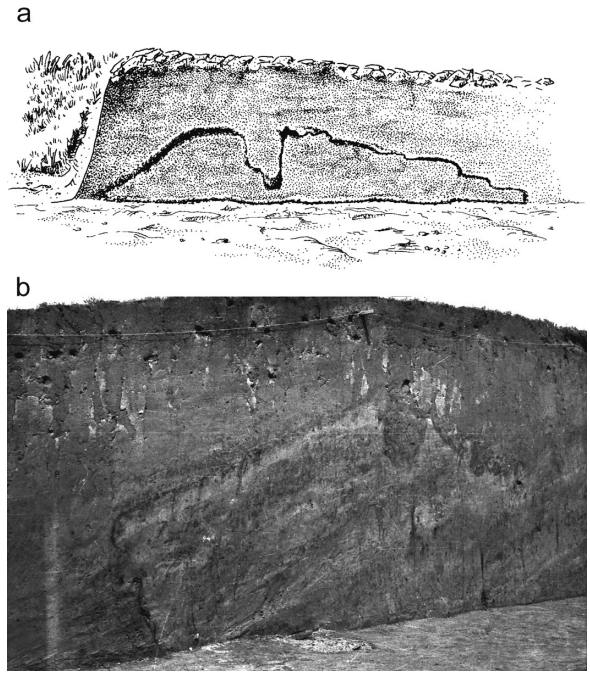
[18] Na južnem delu objavljenega profila (Gabrovec et al. 2006, pril. 2) je vrhnje nasutje po našem mnenju zmotno označeno kot podhumusna rjavkasta plast. Naša korektura je tu označena kot svetlejši odtenek nasutja.

(2024, 130–132, sl. 5–8), ki domneva, da je bilo iz ruše zgrajeno že najstarejše nasutje nad centralnim grobom 19–21. Medtem ko v monografski objavi sive, horizontalno orientirane leče v najstarejšem nasutju niso bile dokumentirane (prim. Gabrovec et al. 2006, pril. 2), arhivske fotografije in risbe profilov (*sl. 8*; Teržan 2024, sl. 5–8) kažejo, da so bili vsaj posamezni segmenti gomile verjetno res grajeni z režnji ruše.

Na fotografijah (*sl. 8*; glej tudi Teržan 2024, sl. 6–8) pritegne pozornost temneje obarvan stik med domnevnimi režnji ruše in preko njih nasuto zemljino. Ena od možnih razlag zanj je nastanek železovo-manganovih konkrecij oziroma skorij, ki se pogosto oblikujejo na meji različno propustnih materialov z različnimi redoks pogoji.[19] Podobne pedogene novotvorbe so bile dokumentirane v zgodnjebronastodobnih gomilah iz ruše na Danskem, kjer je namerno močenje sredice povzročilo nastanek železovih konkrecij na meji med anoksičnim[20] notranjim delom gomile in bolj zračnim zunanjim plaščem. Nastale konkrecije so zapečatile sredico gomile in omogočile izjemno ohranjenost lesenih krst, v primeru gomile Egtved Storhøj pa celo telesa in oblačil umrlega dekleta (npr. Breuning-Madsen, Holst 1998; Breuning-Madsen, Rønsbo, Holst 2000; Holst, Breuning-Madsen, Rasmussen 2001).

Na možno uporabo ruše pri gradnji velike gomile 48 v Stični opozarja še en pomenljiv stratigrafski detajl. Pod najstarejšim nasutjem, ki prekriva centralni grob 19–22, je bila v kontrolnih profilih dokumentirana približno 10–50 cm debela temno siva plast, ki navzdol prehaja v rumeno plast, iz katere mestoma izdanja živa skala (*sl. 7*; glej tudi Gabrovec et al. 2008, pril. 2). Opisano zaporedje je mogoče interpretirati kot pokopana organo-mineralni (A) in mineralni (E ali B) horizont naravnih tal na mestu gradnje najstarejše gomile. Ker je bil pokopani horizont A v *profilu E* ohranjen le pod najstarejšim nasutjem, ne pa tudi pod mlajšimi razširitvami gomile (*sl. 7*; glej tudi Gabrovec et al. 2008, pril. 2), se kot ena od možnih razlag ponuja domneva, da so rušo za gradnjo pridobivali v neposredni bližini gomile (prim. Borisov et al. 2019, 128, sl. 6).

Namenska odstranitev ruše na lokaciji odpira vprašanje urejanja prostora znotraj kamnitega venca. Možno je, da so bila tla med vencem in gomilnim plaščem načrtno vzdrževana na nivoju rumenkastih mineralnih podpovršinskih horizontov (prim. Parzinger 2017, 334, sl. 2). V tem primeru



Sl. 8: Gradnja z režnji ruše in tvorba železovo-manganovih skorij na meji različno propustnih materialov: **a** – zgodnjebronastodobna gomila Egtved Storhøj (po Breuning-Madsen, Holst 1998, sl. 2). Železovi skorji se pojavljata na meji med z vodo prepojeno rušo v sredici gomile in bolj suhimi režnji ruše v preostalem delu gomilnega plašča (zgoraj) ter na meji med sredico gomile in pokopanimi tlemi pod gomilo (spodaj); **b** – del profila velike gomila 48 v Stični, dokumentiran med izkopavanji leta 1962. V osrednjem delu profila je vidno izmenjavanje svetlejših in temnejših plasti ter železovo-manganova skorja, ki jih obrobljа (arhiv NMS, št. 30290; Teržan 2024, sl. 6).
Fig. 8: Construction using sod blocks and the formation of iron-manganese crusts at boundaries between materials of differing permeability: **a** – the Early Bronze Age Egtved Storhøj burial mound (after Breuning-Madsen, Holst 1998, Fig. 2). Iron crusts occur at the boundary between the water- saturated turf in the mound core and the drier turf blocks in the remainder of the mound fill (above), and at the boundary between the mound core and the buried soil beneath the mound (below); **b** – part of *section E* of the large Tumulus 48 at Stična, documented during the 1962 excavations. Alternating lighter and darker layers, with an iron-manganese crust visible along their boundary, can be seen in the central part of the section (NMS Archives, no. 30290; Teržan 2024, Fig. 6).

[19] Stopnja prezračenosti tal. V tleh lahko vladajo oksidacijski, redukcijski ali anoksični pogoji.

[20] Anoksični oz. anaerobni pogoji v tleh (tj. popolna odsotnost kisika) nastopijo, ko so pore v tleh v celoti zapolnjene z vodo, koncentracija raztopljenega kisika v talnih porah pa je praktično ničelna, zato vsi aerobni procesi prenehajo, mikroorganizmi pa presnovo preusmerijo na anaerobne redoks procese. Takšne razmere so značilne predvsem za vodno nasičena in/ali organsko bogata tla.

bi kombinacija belega kamna v vencu, svetlih mineralnih tal brez rastja in verjetno s travo poraslega gomilnega plašča ustvarjala izrazit vizualni kontrast, ki bi lahko morda imel poleg praktične konotacije tudi simbolen pomen.

Vpliv pedogenih procesov na stratigrafijo gomile 48 odražajo tanke svetlo sive plasti, vidne na mejah med posameznimi rumenkasto sivimi nasutji, s katerimi so gomilo od 8. do zgodnjega 5. st. pr. n. št. postopoma povečevali (*sl. 7*; glej tudi Gabrovec et al. 2008, pril. 2). Omenjene plasti bi lahko predstavljale začetno fazo razvoja horizonta A na površini gomile v obdobjih po vsakokratnem nasutju, za katera sta bila značilna sedimentacijski hiatus in stabilizacija površine, ki sta omogočila intenzivnejše pedogene procese. Podobno stratigrafsko situacijo zasledimo tudi v gomili 139 na Budinjaku, v kateri bi lahko tanka, rahla, rjava plast med prvim in drugim nasutjem prav tako odražala razvoj horizonta A na starejši površini gomile pred naslednjo fazo povečanja (Škoberne 1999, 43–107, sl. 26–27).

Tretji način gradnje zasledimo v gomilah, pri katerih makroskopski opisi kažejo na uporabo treh ali več tipov gradiva (*sl. S1*). Mednje sodijo predvsem manjše in srednje velike gomile tipov 2 in 3, na primer gomila 17 na Grmadi pri Molniku (Tecco Hvala 2017, 48–60, 82, sl. 44–45, 83; Škvor Jernejčič 2017, 93), gomila 5 v Stični (Gabrovec et al. 2006, pril. 3–4; Kruh 2008, 69–71) in gomila 9 v Sajevcah pri Kostanjevici (Guštin, Preložnik 2005, 121–130, sl. 11).

Posebej povedna je stratigrafija gomile 5 v Stični, pri kateri je bilo makroskopsko opisanih več tipov zemljine: plast sivorumene ilovice, uporabljena za izravnavo površine; tanjša plast oranžnordeče zemljine nad njo, ki je bila morda uporabljena kot zaključek izravnave;[21] rdečerjava zemljina najstarejšega gomilnega plašča nad centralnim grobom s kamnito konstrukcijo in mlajša rjava plast, ki naj bi bila povezana z drugo fazo povečanja gomile. V gomili so bile dokumentirane tudi sivorumene leče, ki bi lahko predstavljale dodatna nasutja (Gabrovec et al. 2006, pril. 3–4; Kruh 2008, 69–71).

Ker našteti tipi gradiva niso bili geoarheološko analizirani, ni mogoče zanesljivo presoditi, v kolikšni meri opisane plasti dejansko predstavljajo uporabo različnih gradbenih materialov in v kolikšni meri odražajo vpliv poznejših pedogenih procesov na stratigrafijo gomil. Podobno kot pri gomili v Mačkovcu (Udovč 2009) je mogoče predlagati hipotezo, da je vrhnje rjavo gradivo nastalo s poznejšim pedogenim preoblikovanjem prvotnega gomilnega plašča. Prav tako ostaja odprto vprašanje, ali posamezne sivorumene leče predstavljajo dodatna nasutja (prim. Gabrovec et al. 2006, pril. 4) ali zgolj lokalne pedogene spremembe znotraj rdečerjave zemljine prvega nasutja.

Makroskopsko dokumentirani podatki vendarle kažejo, da je bila pri nekaterih gomilah tipa 3 posebna pozornost namenjena pripravi površine, na kateri je bila postavljena grobna konstrukcija centralnega groba (glej tudi Škoberne 1999, 43–107, sl. 26–27). Uporaba različnih, zlasti rdečkasto obarvanih zemljin pri pripravi podlage, kot na primer pri gomili 5 iz Stične in gomili 139 na Budinjaku, bi lahko odražala bodisi pragmatično uporabo na lokaciji dostopnih materialov bodisi zavestno izbiro gradiva. Brez mikromorfoloških, pedoloških in geokemijskih analiz izvora teh materialov ter njihove morebitne simbolne vloge ni mogoče zanesljivo presojati. Podobno velja za organske materiale, ki so lahko bili vključeni v gradnjo gomil ali opremo grobov. Njihova prisotnost je v makroskopskem stratigrafskem zapisu pogosto neprepoznavna, zato jih je mogoče identificirati in raziskovati predvsem z mikromorfološkimi, geokemijskimi in biomolekularnimi metodami (npr. Sulas et al. 2022).

Obravnavani primeri kažejo, da makroskopsko opisane plasti ne predstavljajo nujno posameznih gradbenih faz. Del opaženih razlik lahko odraža poznejše pedogene in sedimentacijske procese, ki so po gradnji gomil spremenili prvotne lastnosti gradiva (prim. Hejcman et al. 2013; Kabała et al. 2019). Brez vključitve geoarheoloških analiz zato pogosto ni mogoče zanesljivo razlikovati med primarnimi gradbenimi plastmi in sekundarnimi preoblikovanji gomilnega plašča. Primerjalna analiza kaže tri osnovne načine uporabe gradbenega materiala: gradnjo iz enega tipa zemljine, kombinacijo dveh različnih tipov gradiva in uporabo več različnih materialov v več zaporednih gradbenih fazah. Pri nekaterih gomilah se kot dodatna možnost kaže tudi uporaba ruše. Raznolikost gradbenih materialov se dobro ujema s predlaganimi modeli gradnje gomil (*sl. 2–4*). Gomile tipa 1 praviloma kažejo uporabo enotnega gradiva, medtem ko sta pri tipih 2 in 3 pogostejša kombiniranje različnih zemljin, večfazno povečevanje gomile in morebitna uporaba dodatnih konstrukcijskih elementov.

[21] Čeprav je bila dokumentirana v profilu (prim. Gabrovec et al. 2008, pril. 4), Kruhova (2008, 70–71) o tej plasti ne razpravlja.

PEZDIRČEVA NJIVA – PRIMER UPORABE GEOARHEOLOŠKIH METOD V ŠTUDIJAH GOMIL

Pezdirčeva njiva je obsežno železnodobno grobišče na pobočju Kučarja pri Podzemlju. Naselbina na vrhu hriba je bila poseljena od 9. do konca 1. st. pr. n. št. (Grahek, Kovač 2020, 441–446, 450), medtem ko je bilo grobišče v uporabi v mladohalštatskem in latenskem obdobju (Grahek 2025, 189–196). Med letoma 2017 in 2021 je bilo raziskanih 182 grobov, pri čemer so bili vsi ohranjeni le še v mineralnih horizontih B, brez vidnih ostankov gomilnih plaščev (Grahek 2025, 103–139).

V geoarheološki preiskavi Pezdirčeve njive smo obravnavali dve temeljni metodološki vprašanji. Prvič, kako prepoznati uničene gomile na območjih, kjer se topografski ali stratigrafski znaki nasutja niso ohranili. In drugič, ali lahko z dostopnimi podatki rekonstruiramo razvoj tal na najdišču in prepoznamo vpliv naravnih pedo-sedimentarnih procesov na arheološki zapis. Geoarheološke raziskave so bile izvedene na štirih profilih znotraj grobišča (P1–P4) in dveh kontrolnih profilih izven grobišča (P5–P6) (*sl. 9*). Analize so vključevale pedološke opise, laboratorijske določitve teksture, pH, karbonatov, organske snovi, CN razmerja, kationske izmenjalne kapacitete, nasičenosti sorptivnega dela tal z bazičnimi kationi, mikromorfološko analizo ter geomorfološko analizo petih elementov pobočja (Prijatelj, Turniški, Grčman 2025).

Primerjava rezultatov je pokazala, da se profila P2 in P3, ki ležita znotraj domnevnih gomil, razlikujeta od naravnih profilov po povečani vsebnosti glinene frakcije v površinskih horizontih. Takšen teksturni signal je bil interpretiran kot ostanek erodiranega gomilnega plašča, zgrajenega iz mineralne, z glino bogatejše zemljine, ki se je zaradi dolgotrajne poljedelske rabe postopoma premešala z ornico (Prijatelj, Turniški, Grčman 2025). Na tej podlagi je bil oblikovan model erozije in lateralnega premeščanja gomilnega gradiva z dolgotrajnim oranjem (*sl. 10*), ki pojasnjuje, zakaj se po popolnem izginotju gomil iz reliefa njihov teksturni signal deloma ohrani v površinskih horizontih tal.

Pomemben rezultat raziskave je bilo tudi razlikovanje med naravno in antropogeno pokopanimi tlemi. V profilu P3 je bil pod eno izmed domnevnih gomil dokumentiran pokopani horizont A, ki je bil prekrit ob nasutju gomile, medtem ko je bil pokopani horizont A v profilu P1 na območju latenskih planih grobov posledica poznejšega koluvialnega zasipavanja (Prijatelj, Turniški, Grčman 2025). Razločevanje med obema tipoma pokopanih tal je bilo mogoče le z združitvijo pedostratigrafskih, laboratorijskih in arheoloških podatkov.

Celotno zaporedje naravnih in antropogenih procesov je bilo povzeto v konceptualnem modelu razvoja tal na najdišču (*sl. 11*). Model prikazuje štiri glavne razvojne faze: 0 – nastanek naravnih tal na resedimentiranem gradivu v obdobju holocena, 1 – antropogeni poseg v prostor z gradnjo gomil v mladohalštatskem obdobju, 2 – pokop tal na grobišču s koluvialnim gradivom v času antike ali pozneje in 3 – dolgotrajna novoveška poljedelska raba, zaradi katere so bili gomilni plašči postopoma erodirani in premešani z ornico (Prijatelj, Turniški, Grčman 2025; Prijatelj, Grčman 2025).

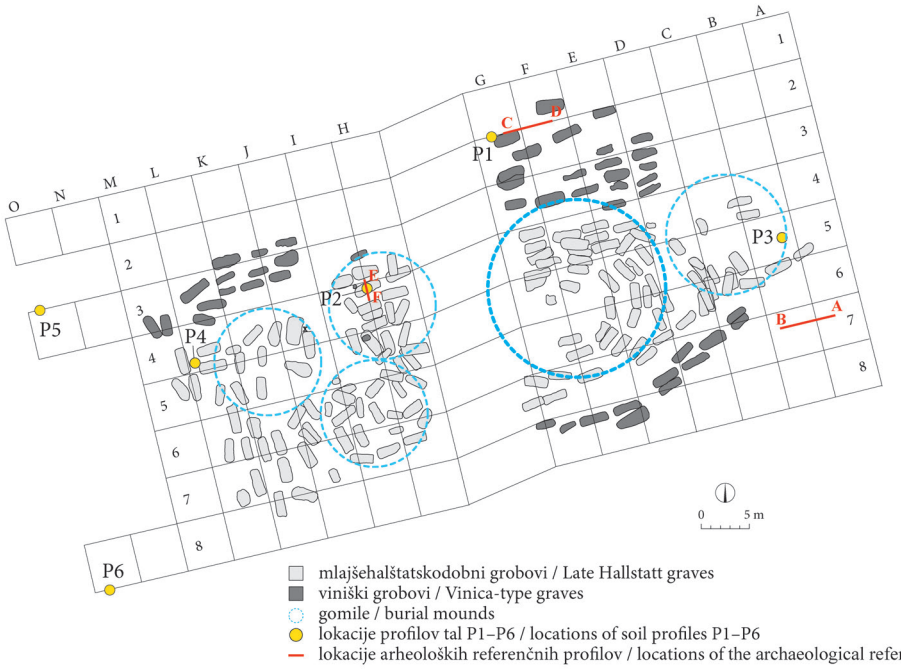
Študijski primer Pezdirčeve njive tako kaže, da makroskopsko opazovanje stratigrafije pogosto ne zadošča za rekonstrukcijo vseh naravnih in antropogenih procesov na območju erodiranih gomil. Šele povezava arheoloških opazovanj z

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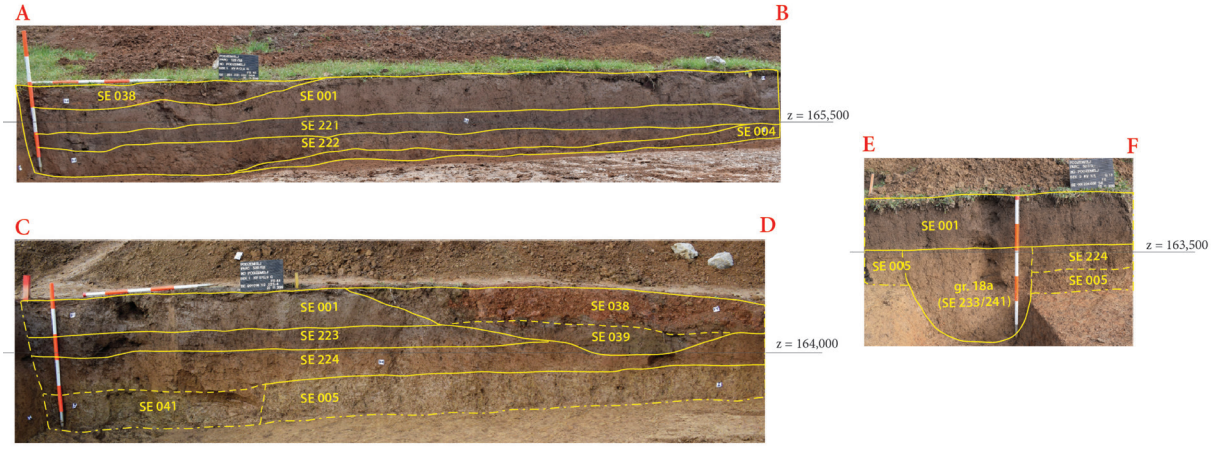
Sl. 9: Pezdirčeva njiva v Podzemlju: **a** – tloris grobišča z označenimi lokacijami pedoloških profilov P1–P6 in referenčnih arheoloških profilov A–B, C–D in E–F (po Prijatelj, Turniški, Grčman 2025, sl. 1); **b** – referenčni arheološki profili (po Grahek 2025, sl. 2.8). V profilih A–B in C–D sta bili plasti SE 221 in SE 223 identificirani kot s koluvijalnimi procesi pokopan horizont A (Ab); **c** – pedološki profili P1–P6 (po Prijatelj, Turniški, Grčman 2025, sl. 2), ki shematično prikazujejo lokacije odvzetih porušenih vzorcev (rumene pike) in mikromorfoloških blokov (oranžni pravokotniki). Z zvezdico (*) označeni horizonti B v profilih P1 in P2 predstavljajo ohranjene spodnje dele polnil grobnih jam. Zaradi poodložitvenih procesov homogenizacije ti na podlagi morfoloških značilnosti in večine analiziranih parametrov izkazujejo predvsem lastnosti, značilne za pedogenetske procese, zato so v tej študiji obravnavani tudi kot talni horizonti.

Fig. 9: Pezdirčeva njiva in Podzemelj: **a** – plan of the cemetery showing the locations of soil profiles P1–P6 and reference archaeological sections A–B, C–D and E–F (after Prijatelj, Turniški, Grčman 2025, Fig. 1); **b** – reference archaeological sections (after Grahek 2025, Fig. 2.8). In sections A–B and C–D, layers SU 221 and SU 223 were identified as an A horizon buried by colluvial processes (Ab); **c** – soil profiles P1–P6 (after Prijatelj, Turniški, Grčman 2025, Fig. 2), schematically showing the locations of bulk samples (yellow dots) and micromorphology blocks (orange rectangles). The B horizons marked with an asterisk (*) in profiles P1 and P2 represent the preserved lower parts of grave-pit fills. Due to post-depositional homogenisation processes, their morphological characteristics and most of the analysed parameters predominantly reflect pedogenic modifications; they are therefore also treated as soil horizons in this study.

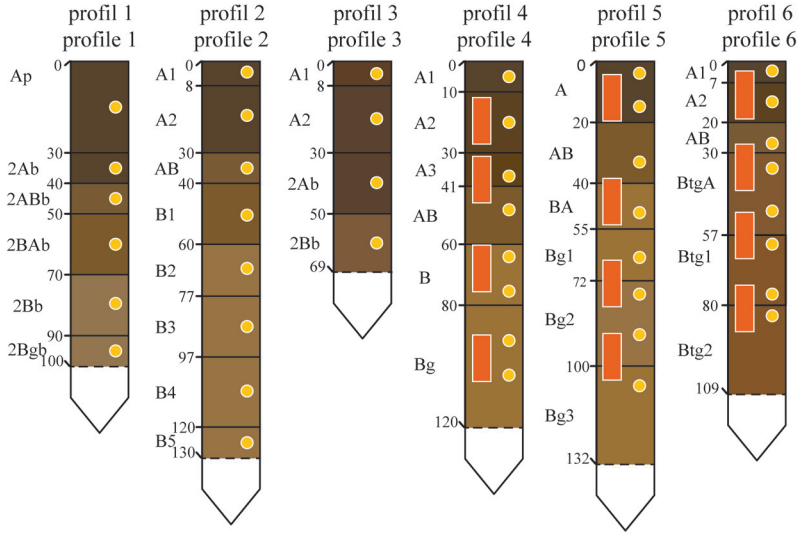
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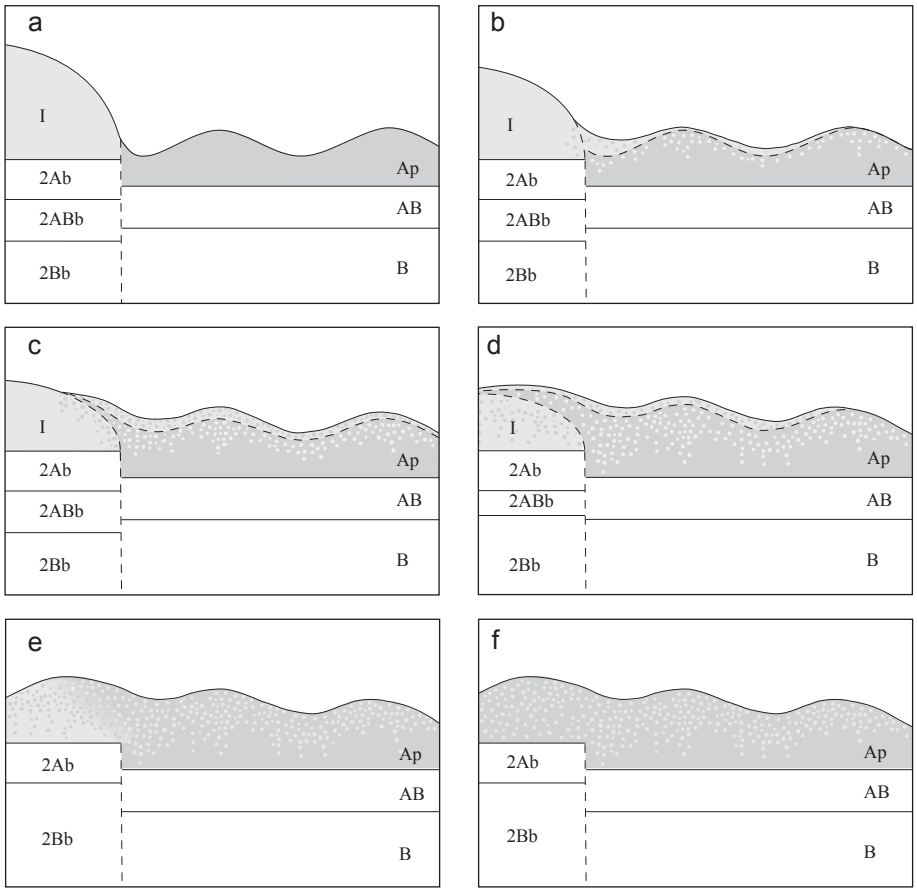

O N M L K J I H G F E D C B A
1 2 3 4 5 6 7 8
P1
P2
P3
P4
P5
P6
C
D
E
F
A
B
0 5 m
mlajšehalštatskodobni grobovi / Late Hallstatt graves
viniški grobovi / Vinica-type graves
gomile / burial mounds
lokacije profilov tal P1–P6 / locations of soil profiles P1–P6
lokacije arheoloških referenčnih profilov / locations of the archaeological reference profiles

b


A
B
SE 038
SE 001
SE 221
SE 222
SE 004
z = 165,500
C
D
SE 001
SE 038
SE 223
SE 039
SE 224
SE 041
SE 005
z = 164,000
E
F
SE 001
SE 005
SE 224
SE 005
gr. 18a
(SE 233/241)
z = 163,500

c


profil 1
profile 1
Ap
2Ab
2ABb
2BAb
2Bb
2Bgb
profil 2
profile 2
A1
A2
AB
B1
B2
B3
B4
B5
profil 3
profile 3
A1
A2
2Ab
2Bb
profil 4
profile 4
A1
A2
A3
AB
B
Bg
profil 5
profile 5
A
AB
BA
Bg1
Bg2
Bg3
profil 6
profile 6
A1
A2
AB
BtgA
Btg1
Btg2

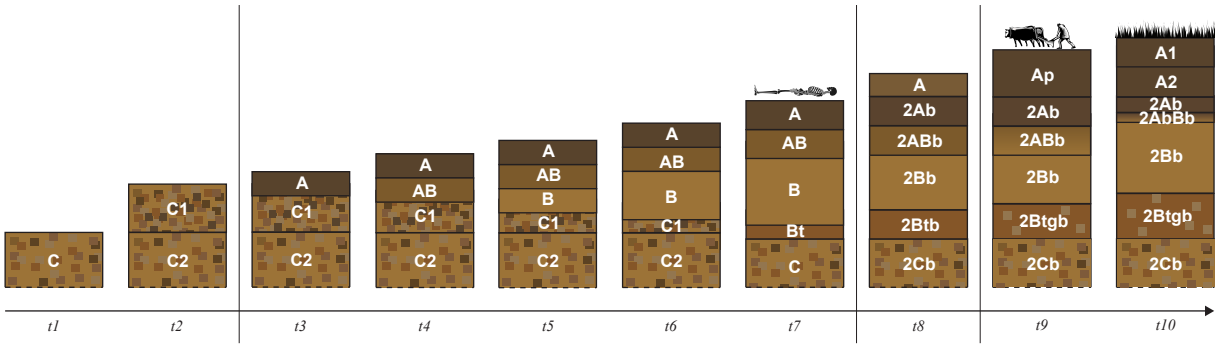


Sl. 10: Erozija, premeščanje in odlaganje gradiva gomilnega plašča z oranjem: **a** – pojav poljedelskih površin na območju z gomilami; **b** – začetek premeščanja gradiva z oranjem in erozijsko-koluvijalnimi procesi ter odlaganje predvsem v brazdah; **c** – odlaganje večine premeščenega gradiva v neposredni bližini gomile; **d** – mešanje in homogenizacija gradiva v ornici z nadaljnjim oranjem; **e** – izbris gomile s površja; **f** – popolna homogenizacija podpovršinskih ostankov gomile z ornico (po Prijatelj, Turniški, Grčman 2025, sl. 12).
Fig. 10: Erosion, transport and deposition of mound-fill material through ploughing: **a** – establishment of agricultural fields in an area with burial mounds; **b** – initial redistribution of material through ploughing and erosional-colluvial processes, with deposition occurring mainly in furrows; **c** – deposition of most of the redistributed material in the immediate vicinity of the mound; **d** – mixing and homogenisation of the material within the ploughsoil through continued ploughing; **e** – disappearance of the mound from the ground surface; **f** – complete homogenisation of the subsurface remains of the mound with the ploughsoil (after Prijatelj, Turniški, Grčman 2025, Fig. 12).

geoarheološkimi metodami omogoča razlikovanje med naravnimi pedogenimi procesi, koluvialno sedimentacijo, ostanki gomilnih plaščev in antropogeno pokopanimi tlemi. Zato geoarheološke analize predstavljajo pomembno dopolnitev stratigrafskih raziskav gomil, zlasti na najdiščih, kjer so bile gomile zaradi dolgotrajne rabe prostora povsem izbrisane iz reliefa (Prijatelj, Turniški, Grčman 2025).

ZAKLJUČEK

Na podlagi kritične primerjalne analize objavljene stratigrafske dokumentacije z 11 grobišč smo v prispevku predstavili teoretične modele gradnje gomil dolenjske halštatske skupine (*sl. 2–7*). V mnogih primerih je dokumentacija vsebovala podatke, ki jih je danes z geoarheološke perspektive mogoče interpretirati drugače kot ob času izkopavanj, zlasti glede prepoznavanja gradbenih faz, pokopanih tal, možne uporabe ruše in vpliva tlotvornih procesov na ohranjenost stratigrafskega zapisa. V takšnih primerih ostajajo predlagani modeli in geoarheološke reinterpretacije na ravni raziskovalnih hipotez, ki



Faza 0 (*t1–t2*) – resedimentacija gradiva iz širše okolice Kučarja;
Faza 1 (*t3–t7*) – razvoj tal na resedimentiranem gradivu in rast horizonta B, ko je hitrost sedimentacije manjša od hitrosti pedogeneze;
Faza 2 (*t8*) – pokop tal, ko je hitrost sedimentacije večja od hitrosti pedogeneze;
Faza 3 (*t9–t10*) – razvoj tal ob dolgotrajni kmetijski rabi in rast horizonta A, ko je hitrost sedimentacije enaka hitrosti pedogeneze. /

Phase 0 (*t1–t2*) – re-sedimentation of material from the wider Kučar area;
Phase 1 (*t3–t7*) – soil genesis on the re-sedimented material and B horizon thickening, when the sedimentation rate is lower than the pedogenesis rate;
Phase 2 (*t8*) – soil burial, when the sedimentation rate is higher than the pedogenesis rate;
Phase 3 (*t9–t10*) – soil development under long-term agricultural use and A horizon thickening, when the sedimentation rate is equal to the pedogenesis rate.

Sl. 11: Teoretični model razvoja tal na grobišču Pezdirčeva njiva v Podzemlju (po Prijatelj, Grčman 2025, sl. 2).
Fig. 11: Theoretical model of soil development at the Pezdirčeva njiva cemetery in Podzemelj (after Prijatelj, Grčman 2025, Fig. 2).

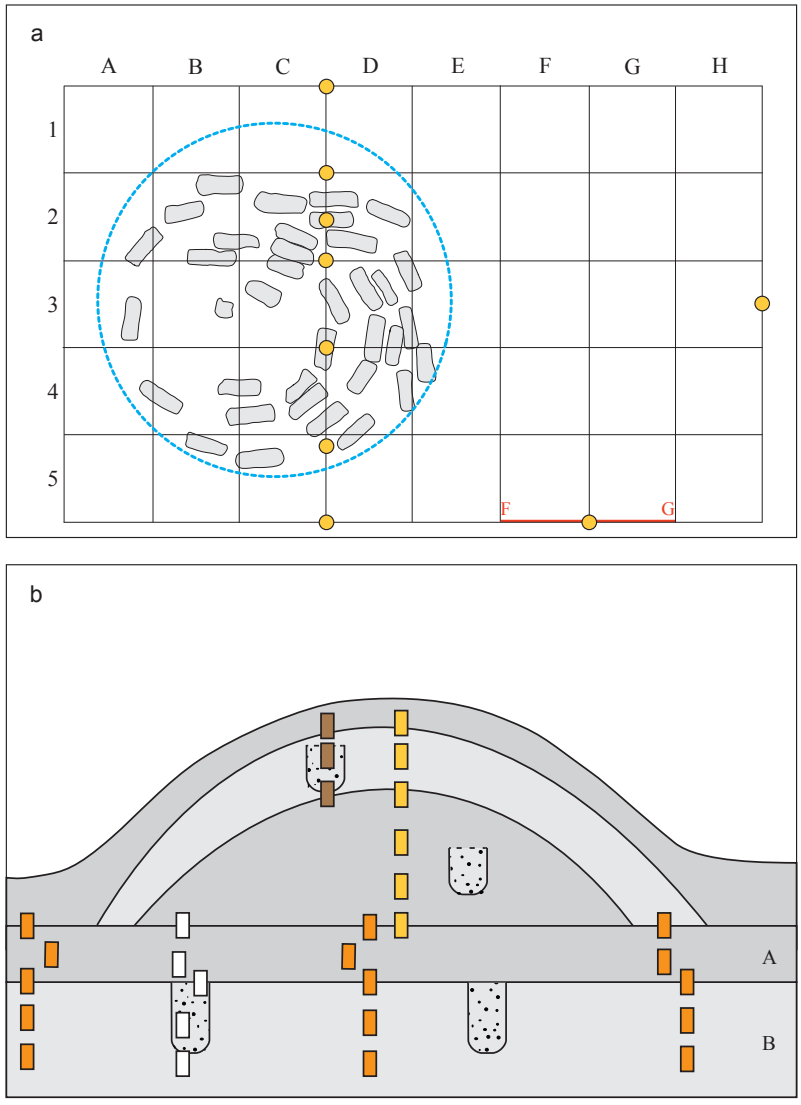
jih bo mogoče v prihodnje preverjati predvsem z vključevanjem sodobnih geoarheoloških metod v raziskave gomil.

Iz predstavljenih modelov je razvidno, da so se gomile razlikovale tako po načinu gradnje kot po načinu umeščanja grobov v gomilni plašč. Na današnjo podobo stratigrafskega zapisa so pomembno vplivali tudi poodložitveni pedogeni in sedimentacijski procesi, ki so v nekaterih primerih verjetno privedli do nastanka plasti neantropogenega izvora. Na podlagi primerjalne analize gradbenih materialov smo prepoznali tri osnovne načine gradnje gomil: uporabo enega tipa zemljine, kombinacijo dveh tipov gradiva in večfazno gradnjo z več različnimi materiali. Pri posameznih gomilah dolenjske halštatske skupine se kot dodatna možnost kaže tudi uporaba ruše.

Potencial geoarheološkega pristopa ponazarja študijski primer Pezdirčeve njive, predstavljen na podlagi rezultatov že objavljene raziskave (Prijatelj, Grčman 2025; Prijatelj, Turniški, Grčman 2025). Na tem najdišču je kombinacija geomorfoloških, pedoloških in mikromorfoloških analiz omogočila prepoznavanje popolnoma erodiranih gomil, razlikovanje med antropogeno in naravno pokopanimi tlemi ter rekonstrukcijo ključnih pedo-sedimentarnih procesov, ki so vplivali na ohranjenost arheološkega zapisa. Primer potrjuje, da lahko geoarheološke metode pomembno dopolnijo klasično stratigrafsko analizo na najdiščih, kjer nadzemne strukture niso več ohranjene.

Predstavljeni rezultati kažejo na pomen sistematičnega vključevanja geoarheoloških analiz v prihodnje raziskave gomilnih grobišč. Pri erodiranih gomilah bi bilo smiselno sistematično vzorčenje profilov znotraj območja gomile, tako znotraj kot izven grobnih jam, profilov na grobišču izven območja gomil ter kontrolnih profilov naravnih tal izven prostora grobišča (*sl. 12:* a). Pri ohranjenih gomilah je poleg sistematičnega vzorčenja vseh plasti gomilnega plašča in polnil grobnih jam ključnega pomena tudi vzorčenje pokopanih tal pod posameznimi nasutji, saj ta omogočajo rekonstrukcijo spreminjajočega se paleookolja skozi čas in oceno vpliva poodložitvenih procesov na gradivo v gomilnem plašču (*sl. 12:* b). Enako pomembno je vzorčenje naravno pokopanih tal na grobišču, ki omogoča razlikovanje med naravnimi sedimentacijskimi procesi in antropogenimi posegi v okolje.

Predlagani raziskovalni okvir združuje stratigrafsko analizo in geoarheološke metode v enoten metodološki pristop. Takšna povezava ne omogoča le zanesljivejšega prepoznavanja gradbenih materialov, tehnologij gradnje in poodložitvenih procesov, temveč dolgoročno tudi vzpostavitev regionalne baze s primerljivim naborom geoarheoloških podatkov o prazgodovinskih gomilah. S tem pa se odpira možnost za širše in primerjalno bolj poglobljene geoarheološke študije gomil.



Sl. 12: Prikaz strategije geoarheološkega vzorčenja gomil: **a** – prostorska razporeditev lokacij vzorčenja (rumene pike) na hipotetičnem gomilnem grobišču. Vzorčimo na več točkah znotraj gomile, vključno na območju izbranih grobov in v neposredni bližini gomile. V primeru dokumentiranih pokopanih tal izven območja gomil (profil F–G) vzorčimo tudi ta. S pomočjo vzorčenja profilov tal izven območja grobišča (na tlorisu točka v kvadrantu H3) pridobimo kontrolo za naravno ozadje najdišča; **b** – razporeditev mikromorfoloških vzorcev znotraj hipotetičnega profila ohranjene gomile. Serije vzorcev umeščamo v profil v skladu z raziskovalnimi vprašanji. Serija rumenih vzorcev zajema celotno sekvenco nasutij v gomilnem plašču in je namenjena karakterizaciji gradbenega materiala ter načina gradnje gomilnega plašča. Serija oranžnih vzorcev zajema kontakt med gomilo in pokopanimi tlemi pod gomilo. S to serijo sledimo paleookoljskim podatkom v pokopanih tleh ter iščemo podobnosti in razlike med tlemi, ki so bila pokopana v različnih fazah gradnje gomile. Serija belih in rjavih vzorcev se osredotoča na grobove v gomili. Z njima karakteriziramo polnila grobnih jam, analiziramo ohranjenost vkopov in opazujemo vpliv pedogenih procesov na ohranjenost arheološkega zapisa.

Fig. 12: Geoarchaeological sampling strategy for tumuli: **a** – spatial distribution of sampling locations (yellow dots) within a hypothetical tumulus cemetery. Samples are taken at several locations within the tumulus, including the areas of selected graves, as well as in its immediate vicinity. Where buried soils are documented outside the tumulus area (section F–G), these are also sampled. A soil profile outside the cemetery (grid square H3) provides a control for the natural background conditions at the site; **b** – distribution of micromorphology samples within a hypothetical section of a preserved tumulus. Sample series are positioned according to the research questions. The yellow sample series covers the entire sequence of mound fills and is intended to characterise the construction materials and the method of mound construction. The orange sample series covers the contact between the mound and the buried soil beneath it and is used to investigate palaeoenvironmental information preserved in the buried soils and to identify similarities and differences between soils buried during different phases of mound construction. The white and brown sample series focus on graves within the mound and are used to characterise grave-pit fills, assess the preservation of grave cuts and investigate the effects of pedogenic processes on the preservation of the archaeological record.

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Tumuli of the Dolenjska Hallstatt Group: A Geoarchaeological Reinterpretation of the Stratigraphic Record

Translation

Geoarchaeological methods approach archaeological deposits as artefacts (Miller 2011, 104) and as a fundamental source of information on human activities and the natural environment. They investigate the stratigraphic record using methods such as micromorphology, sedimentological and pedological analyses, and geophysical techniques, often in combination with palaeoenvironmental research (Goldberg, Macphail 2006; Rapp, Hill 2018; Karkanas, Goldberg 2019).

In Europe and beyond, geoarchaeology has made an important contribution to the understanding of tumuli in recent decades (Goldberg, Macphail 2006, 227–235; Macphail, Goldberg 2018, 224–226; Karkanas, Goldberg 2019, 219–221). Analyses of construction materials have shown that burial mounds were constructed from a variety of sediments and soils of local or more distant origin, as well as from anthropogenic and biogenic materials.[1] Studies have identified single-stage mound construction with natural materials, the use of different combinations of materials, and multi-phase or generational enlargement of burial mounds (e.g. Clay 1986; Kidder, Ortmann, Allen 2004; Cremeens 2005; Sherwood, Kidder 2011; Hejcman et al. 2013; Borisov et al. 2019; Kabała et al. 2019; Cannell, Bill, Macphail 2020, Cannell 2021; Gkouma, Karkanas, Iacovou 2021; Cseh et al. 2022; Khokhlova et al. 2022).

Among natural construction materials, the most important were various types of sediment, soil, and turf. Their mechanical properties and limitations influenced construction strategies. Where soils and sediments were used, the selected unconsolidated material was first excavated and then deposited from a relatively low height, most likely using shovels, baskets, and various larger containers (e.g. Cremeens 1995; 2005; Cremeens, Landers, Frankenberg 1997; Papadopoulos, Bejko, Morris 2008; Sherwood, Kidder 2011; Ortmann, Kidder 2013); in the case of monumental structures, auxiliary ramps and carts may also have been used (e.g. Ortmann, Kidder 2013; Gkouma, Karkanas, Iacovou 2021). The manner in which soils and sediments were deposited could produce sedimentary structures

[1] Anthropogenic materials documented within tumuli include sun-dried mud bricks (Khokhlova, Nagler 2020; Mikhaylova et al. 2025) and lime coatings (Gaggioli, Van Damme 2025, 7, 11, 16), while biogenic materials include intentionally or unintentionally incorporated animal dung (Macphail et al. 1998, 638–640, Fig. 9; Khokhlova et al. 2022, 412, Fig. 9: e,f).

identical to those resulting from natural slope processes. Gravity-driven movement of material during construction may have caused dry flows, slumping, or inverse grading, all of which can be identified by micromorphological analysis (Karkanas et al. 2012, 2728–2730; Gkouma, Karkanas, Iacovou 2021, 611–612; Gaggioli, Van Damme 2025, 15, Fig. 7). The construction of larger tumuli may also have involved additional techniques of material preparation, such as wetting (e.g. Cremeens 2005, 591–593, Fig. 5; Gkouma, Karkanas, Iacovou 2021, 612, Fig. 8), or the alternating use of different soil types and compaction. These practices improved structural stability and resulted in the formation of specific micromorphological features within the construction material (Sherwood, Kidder 2011; Gkouma, Karkanas, Iacovou 2021; Gaggioli, Van Damme 2025; Khokhlova et al. 2022).

Turf was another important material used in a range of prehistoric burial-mound-building traditions (Macphail et al. 1998; 2013; Holst, Breuning-Madsen, Rasmussen 2001; Van Nest et al. 2001; Robin 2010; Doorenbosch 2013; Breuning-Madsen et al. 2016; Parzinger 2017; Borisov et al. 2019; Cannell 2021; Makeev et al. 2021). It is a composite natural material consisting of the uppermost layer of soil covered by vegetation, especially grass. Its dense root system binds the soil material (the A horizon and the upper part of the E or B horizon[2]) and prevents it from falling apart. These properties required different preparation and construction techniques: unlike unconsolidated soils and sediments, which were excavated and deposited, turf was cut into blocks of various shapes and then stacked more or less systematically into a hemispherical mound.

Geoarchaeological studies have identified different ways in which turf was used, ranging from the construction of entire burial mounds to its use only in the core or in part of the mound fill (Breuning-Madsen, Holst 1998; Breuning-Madsen, Rønsbo, Holst 2000; Doorenbosch 2013; Cannell, Bill, Macphail 2020; Makeev et al. 2021). The identification of turf in the stratigraphic record depends on the properties of the source soil and on subsequent pedogenic processes. In well-preserved examples, individual turf blocks are visible as alternating lighter and darker layers, but intensive mineralisation of organic material and pedogenesis can gradually blur these features or completely homogenise the deposits (Borisov et al. 2019, 129; Makeev et al. 2021). This constitutes an important limitation when interpreting older stratigraphic descriptions, in which the characteristics of construction phases, the materials used, and post-depositional processes were often not systematically documented.

Buried soils beneath burial mounds are an important source of environmental information, since mound deposits often preserve the state of the soil at the time of construction. The analysis of buried soils enables palaeoenvironmental reconstruction and can also assist in identifying later pedogenic and sedimentary processes that transformed the stratigraphic record of the tumulus (Dreibrodt et al. 2009; Doorenbosch 2013; Hejcman et al. 2013; Hildebrandt-Radke et al. 2019; Kabała et al. 2019; Makeev et al. 2021; Khokhlova et al. 2022; Sverchkova, Khokhlova 2025; Mikhaylova et al. 2025).

A geoarchaeological approach thus enables a more precise interpretation of tumulus stratigraphy by integrating analyses of construction materials and building techniques with evidence for palaeoenvironmental conditions and natural processes that took place after the burial mounds were constructed. Every tumulus embodies a sequence of planned decisions and actions, from the selection and organisation of the construction site within the cemetery, the organisation of labour, and the selection and procurement of construction materials, through different building techniques, to the deliberate maintenance and care of the mound's external appearance (Sherwood, Kidder 2011, 83–84). The integration of micromorphology and other geoarchaeological methods into research on tumuli also

[2] Horizons are soil layers generally parallel to the soil surface that have formed through soil-forming processes. They differ from the adjacent soil layers in one or more morphological, physical, or chemical properties. The five basic soil horizons are the O, A, E, B, and C horizons. The O horizon forms through the accumulation of organic matter at the soil surface under aerobic conditions and contains more than 35% organic matter. The A horizon forms in the upper part of the soil profile and is usually darker than the underlying horizon. It contains a lower proportion of organic matter than the O horizon, with most of it already humified and bound to mineral components. The E horizon is usually lighter in colour than the overlying O or A horizon and, as a result of eluviation, contains less clay, organic matter or sesquioxides than the underlying illuvial horizon. The B horizon forms through the weathering of parent material and the in situ formation of secondary minerals. It generally occurs beneath O and A horizons and above the parent material and may vary in colour, for example from brown to yellowish-brown or reddish-brown. The C horizon consists of relatively unaltered unconsolidated or fragmented parent material and occurs beneath an A, E, or B horizon.

provides insight into broader processes of interaction between prehistoric communities and their environment, as well as into the technical knowledge and skills involved in constructing funerary monuments from different natural, anthropogenic, and biogenic materials. Such an approach can also contribute to understanding the potential symbolic meanings of selected construction materials, for example those associated with their visual and tactile properties, provenance, and the effort required to obtain them (Cannell 2021, 698–701).

Until recently, geoarchaeological research on tumuli in Slovenia focused primarily on the analysis of LiDAR data and the use of geophysical methods (e.g. Mušič, Črešnar, Medarić 2014, 32–34; Mušič et al. 2015, 47–57; Mušič, Horn, Črešnar 2024). The methodological repertoire was broadened by research at the Early Iron Age cemeteries of Pezdirčeva njiva in Podzemelj (Prijatelj, Grčman 2025; Prijatelj, Turniški, Grčman 2025) and Habakuk below Poštela (Prijatelj et al. 2025), where micromorphology and geomorphological, pedological, and palynological analyses were incorporated into the study of tumuli and the wider cemetery area. In the following sections, we present a geoarchaeological reinterpretation of the stratigraphy of tumuli of the Dolenjska Hallstatt group, together with a brief synthesis of the previously published geoarchaeological study of Pezdirčeva njiva. On the basis of the available stratigraphic data, we formulate hypotheses concerning the use of different construction materials, building techniques, and the placement of graves within tumuli of the Dolenjska Hallstatt group. The case study of Pezdirčeva njiva is then used to illustrate the potential of geoarchaeological methods for investigating eroded mounds that have been completely erased from the surface by agricultural land use.

THE STRATIGRAPHIC RECORD OF THE TUMULI OF THE DOLENJSKA HALLSTATT GROUP AND THEORETICAL MODELS OF BURIAL MOUND CONSTRUCTION

Tumuli are one of the defining features of the Early Iron Age cultural landscape of the Dolenjska Hallstatt group (Gabrovec 1964–1965; 1966; 1987; 1999; 2008; Dular, Tecco Hvala 2007, 123–126; Teržan 2020). Owing to a long history of research extending back to the second half of the nineteenth century, they rank among the most important archaeological sources for the study of the Early Iron Age in the south-eastern Alpine region and form the basis of numerous chronological and culture-historical interpretations (Dular 2003; Teržan 2020). In keeping with the Slovenian research tradition (Dular 2003; Teržan 2020), the present study also includes the cemetery at Budinjak (cf. Škoberne 2004).

On the basis of modern excavations at 11 tumulus cemeteries (*Fig. 1*), the available stratigraphic data, and the excavators' interpretations, three theoretical models are presented below, each representing different modes of burial mound construction and grave placement (*Fig. S1*[3]*; 2–8*). The analysis includes cemeteries for which published reports provide stratigraphic documentation (sections, plans and/or layer descriptions) sufficient to discuss different construction methods. The type and extent of the available data vary considerably among the sites included in the analysis. At some sites, descriptions of tumuli are not systematically supported by sections and layer descriptions (e.g. Škoberne, Bugar 2017); at others, where the tumuli were destroyed by agricultural land use, only plans showing the spatial distribution of grave pits are available (e.g. Križ 2019; Grahek 2025); still others provide both plan and section drawings of the tumuli, as well as systematic descriptions of archaeological layers (e.g. Guštin, Preložnik 2005; Udovč 2009; Tecco Hvala 2017; Tica 2022).

Given the major differences in the preservation of the archaeological record and in the type and extent of the available data, the reliability of tumulus classification inevitably varies among cemeteries. *Figure S1* therefore distinguishes between cases in which well-preserved stratigraphy and directly documented sections allow for a relatively reliable classification, and those in which interpretation relies on several assumptions and should therefore be regarded as a working hypothesis. For multi-phase tumuli of Types 2 and 3, *Figure S1* also explicitly indicates whether the tumulus type had already been proposed by the excavators and authors of earlier publications (*Fig. S1*).

The first model (*Fig. S1; 2*) represents the simplest form of construction, in which the burial mound consisted of a single fill. Following B. Teržan's (2020, 373) classification of tumuli by the number of graves, this construction method

[3] *Figure S1* is available as supplemental data at http://iza.zrc-sazu.si/pdf/razno/AV_78_Prijatelj_Grcman_Grahek_Suppl.pdf

appears to have been used primarily for smaller tumuli. Examples include Tumuli 2 and 3 at Dolge njive near Bela Cerkev, each containing a single grave (Mason 2005, 123–124; Mason, Mlekuž 2016, 111–113, Fig. 10; Armit et al. 2023, 404–406, Fig. 3); Tumuli 21 and 36 at Budinjak, likewise each with a single grave (Škoberne 1999, 21–24, Figs. 7–8); Tumulus 16 at Grmada near Molnik with two graves (Tecco Hvala 2017, 45–46, Fig. 41); and the tumulus at Grofove njive near Drnovo, with five graves (Pavlovič 2014, 493, Fig. 28.3; Tica 2022, 22–24, Fig. 20). Cremation Graves 1, 5[4] and 6 at Roje near Molnik (Puš 1984, 139–144, Figs. 1–5; Tecco Hvala 2017, 82) may also belong to this category. A single fill has also been archaeologically documented in medium-sized tumuli, such as Tumulus 1 at Pleška hosta near Molnik, with 14 graves (Tecco Hvala 2017, 67–69, Figs. 63–65), and the tumulus at Mačkovec near Novo mesto,[5] with 13 graves (Udovč 2009, 10; see also *Fig. S1*).[6]

The tumuli listed above contained cremation, inhumation, or biritual burials (*Fig. S1*). The earliest examples at Budinjak and Molnik date to the very beginning of the Early Iron Age, by the early eighth century BC at the latest, or to the Podzemelj phase (Škoberne, Bugar 2017, 34; Škoberne 2004, 140–144, cf. 20–21; Škvor Jernejčič 2017[7]). According to the excavators, some graves were partly or entirely cut into the soil or bedrock beneath the mound fill (e.g. Puš 1984, Figs. 1–5; Škoberne 1999, 23; Tecco Hvala 2017, 68–78; Tica 2022, 22); others were placed on the ground surface beneath the mound (e.g. Tecco Hvala 2017, 46), while still others were located at different depths within the mound fill (e.g. Škoberne 1999, 23–24; Udovč 2009, 10, Fig. 9). In rare cases, grave pits overlapped (e.g. Udovč 2009, Fig. 9; Tecco Hvala 2017, Fig. 65; Tica 2022, Fig. 20). On the basis of these stratigraphic relationships between graves and mound fill, researchers have reconstructed several different sequences of mound construction and grave placement. In some Type 1 tumuli, such as Tumulus 21 at Budinjak (Škoberne 1999, 23, Fig. 6), graves were first cut into the B horizon of the soil and subsequently covered by the mound. In other cases, such as Tumulus 36 at Budinjak (Škoberne 1999, 23–24, Figs. 6, 8), the mound was first constructed on the former ground surface and graves were subsequently cut into the mound fill. Still other cases combined both scenarios: graves were first cut into the former soil, the burial mound was then constructed, and later graves were subsequently cut into the mound fill (e.g. Udovč 2009, 10, Fig. 9).

The second theoretical model (*Fig. 3*) envisages one or more small tumuli containing cremation graves within their fills, which were subsequently covered by a larger burial mound. This larger mound consisted of one or more fills into which further cremation and inhumation graves, or exclusively inhumation graves, were incorporated (*Fig. S1*). Several small tumuli at Budinjak may represent this type, including Tumulus 6 (Škoberne, Bugar 2017, 90, Fig. 9.5) and Tumulus 51 (Škoberne 1999, 25–26, Fig. 12), both with four graves, and Tumulus 7 with six graves (Škoberne, Bugar 2017, 103–112, Fig. 11.7). Tumulus 17 at Grmada near Molnik, with 10 graves, may also have developed in this way (Škvor Jernejčič 2017, 93; Tecco Hvala 2017, 48–60, 82, Figs. 44–45, 83). Type 2 tumuli were also identified among large mounds containing more than 40 burials. Of these, Tumulus I at Hrib in Metlika is the best documented stratigraphically (Križ 1988, 1990a, 1990b; Grahek 2004, 2014a, 2026[8]). On the basis of certain similarities with Tumulus I, Tumuli VI and 13 at Preloge on Magdalenska gora may have developed in a similar way (cf. Hencken 1978, 41–51.; Tecco Hvala, Dular, Kocuvan 2004, 98–110; Tecco Hvala 2012, 344–346; Figs. 13, 16). Šribar also proposed a similar mode of construction for the St Helena tumulus at Zemelj (Grahek 2014b, 234, Fig. 7).

[4] Tecco Hvala (2017, 82) suggests that all three graves may have been covered by small burial mounds; however, no mound-shaped fill above Grave 5 is visible in Puš's publication (1984, Fig. 2).

[5] For a discussion of the stratigraphy and the number of fills in the Mačkovec tumulus, see the section Construction Materials and *Fig. S1*.

[6] In the case of medium-sized tumuli, such as Tumulus 1 at Pleška hosta and the Mačkovec tumulus, the possibility must also be considered that multiple fills composed of the same material were not distinguishable in the macrostratigraphic record (see, e.g., Tecco Hvala 2017, 67).

[7] In the introduction, Škvor Jernejčič mentions Puš's interpretation of the graves at Roje as having a marking function in the landscape, a feature otherwise characteristic of tumulus burials, whereas in the conclusion she classifies all the graves discussed as flat graves (cf. pp. 89 and 108).

[8] Here, we supplement the primary publication with a data appendix that includes individual finds that were previously unknown and therefore unpublished, as well as previously missing finds, none of which significantly affect the cultural and chronological attribution of the individual burials within the tumulus.

Like the second model, the third theoretical model (*Fig. 4*) envisages multi-phase enlargement of burial mounds, but with several important differences. Whereas in Type 2 a larger burial mound covered one or more smaller tumuli containing urn graves, potentially resulting in an irregular or elongated mound form (cf. Grahek 2004, Fig. 11; Tecco Hvala 2012, 345, Fig. 16), Type 3 tumuli expanded concentrically outwards. The earliest mound fill usually covered either a central inhumation grave, often with a larger and more complex funerary structure such as a timber or stone burial chamber (*Fig. S1*), or an intentionally empty central area. Within this type, we distinguish two variants, Types 3a and 3b, which differ in the spatial distribution of graves in relation to the central grave or the centre of the mound, and probably also in the chronological and spatial relationships between graves and successive mound fills.

The arrangement of graves in Type 3a tumuli was more strictly regulated than in Types 1 and 2, with the inhumation graves of several generations of the deceased arranged tangentially in concentric rings around the perimeter of the mound. This mode of construction and grave organisation was used both for smaller, so-called family tumuli, such as Tumulus 1[9] at Dolge njive near Bela Cerkev, with six graves (Mason 2005, 123–124; Mason, Mlekuž 2016, 111–113, Fig. 10; Armit et al. 2023, 404–406, Fig. 3); Tumulus 9 at Sajevce near Kostanjevica, with four graves (Guštin, Preložnik 2005, 129–130, Fig. 11); Tumulus 10 at Velike Malence, with five graves (Guštin 1996, 119, Fig. 3); Tumulus 139 at Budinjak, with seven graves (Škoberne 1999, 43–107, Figs. 26–27; Škoberne, Bugar 2017, 67–72); and the medium-sized Tumulus 5 at Stična with 27 graves (Gabrovec et al. 2006, Add. 4; Kruh 2008, 69–71). Type 3a was also identified among monumental clan tumuli, of which the large Tumulus 48 at Griže near Stična, with 152 graves, is the best documented stratigraphically (Gabrovec et al. 2006, Add. 2; Gabrovec, Teržan 2008, 39, 40–43, 46; Teržan 2024, 130–132, Figs. 5–8).

In the examples listed above, the tumuli contained either exclusively inhumation graves or a predominance of inhumation graves (*Fig. S1*). Cremation graves occurred mainly within large and medium-sized Type 3 tumuli. These included earlier flat cremation graves of the Late Bronze Age that were subsequently covered by an expanding mound and/or, more rarely, Hallstatt-period cremation graves incorporated into the tumulus (e.g. Gabrovec 2008, 40–41; Kruh 2008, 71–72). Tangentially arranged inhumation graves were often partly or wholly cut into the soil, or placed on the former ground surface and covered by smaller fills around the perimeter of the mound. Once a ring of graves had been completed, the mound was enlarged and raised by the addition of a new fill. Only in the latest phase did burial practice generally change to the extent that graves were placed solely within the different mound fills, i.e. above the level of the former ground surface (e.g. Guštin 1996, Fig. 3; Guštin, Preložnik 2005, Fig. 11; Gabrovec et al. 2006, Add. 2; Gabrovec 2008, 39, 40–43, 46, Figs. 19–20).

In the Type 3b variant (*Fig. S1*), graves often overlap without being arranged tangentially and concentrically around the perimeter of the mound, indicating a less regulated spatial organisation than in Type 3a. This mode of structuring occurs mainly in medium-sized tumuli, as in Tumulus 13 at Grmada near Molnik (Tecco Hvala 2017, 34–44, 82, Figs. 26–27, 83), Tumuli XVI and XVIII at Kapiteljska njiva (Križ 2019, 283–284, 286–287), and perhaps also the tumulus at Mačkovec near Novo mesto (Udovč 2009, 10).[10] Although numerous authors have noted the arrangement of graves in tumuli of this type (e.g. Križ 2019, 137–138; Teržan 2020, 370), they have not discussed the implications for mound construction. In contrast to Type 3a, where a new mound fill is thought to have been added after a ring of burials around the perimeter had been completed, the distribution and stratigraphic position of the graves in Type 3b may suggest a different sequence. The mound may first have been enlarged with a new fill, after which graves were cut into it, perhaps without any special markers indicating their locations within the mound. Tumulus 13 at Pleška hosta near Molnik is particularly unusual among these examples, since nine of its fourteen graves, otherwise difficult to trace stratigraphically, overlapped. This may indicate that, in some cases, several individuals were deliberately buried in the same part of the mound.

In view of the modes of burial mound construction and grave placement presented here, we also consider the theoretical model (*Fig. 5*) developed specifically for the cemetery at Kapiteljska njiva in Novo mesto (Križ 2000, 44; 2019, 28–31, 36, Fig.

[9] This is the first tumulus of the Dolenjska Hallstatt group in which DNA analyses have confirmed kinship ties among the deceased (Armit et al. 2023).

[10] See Fn. 4.

9). The model envisages three principal processes that are thought to have produced the present stratigraphic record at the site: the construction of burial mounds, the cutting of graves into the mounds, and the destruction of the tumuli through modern agricultural land use.

Kapiteljska njiva (*Fig. 1; S1*) is a large multiperiod cemetery where excavations conducted over more than three decades have documented 71 tumuli[11] and more than 300 cremation graves (e.g. Knez 1993; Križ 1997; 2000; 2013; 2019; Bricelj 2003). Together with Budinjak (Škoberne 1999; 2004; Škoberne, Bugar 2017), it is undoubtedly one of the sites with the greatest potential for elucidating changes in funerary practices during the transition from the Urnfield culture to the Hallstatt period (cf. Teržan 2020, 368–373). The long-running field investigations were primarily rescue excavations and largely predated the adoption of modern geoarchaeological methods. The interpretative model therefore rests mainly on the available archaeological data. Cremation graves excavated within individual tumuli but attributed to the flat cemetery of the Late Bronze Age Urnfield culture were also not considered in discussions of the development of the tumuli at the site (Križ 2019, cf. e.g. 257, 273, 287, 316, 337, etc.). We suggest that reconsideration of these graves, combined with geoarchaeological investigation of the cemetery, could substantially refine the interpretation of the site's development.

The model of burial mound construction and grave placement proposed by B. Križ (2019, 28–34) represents one possible interpretation and certainly merits further evaluation. The scenario it envisages was stratigraphically documented in small Type 1 tumuli at Budinjak (cf. Škoberne 1999, 23–24, Figs. 6, 8), so it is entirely possible that some smaller tumuli at Kapiteljska njiva developed in a similar way. On the other hand, the wide range of mound dimensions at the site, differences in the type, number, spatial organisation, and dating of graves within individual tumuli (cf. Križ 2019, 252–343), and parallels with Budinjak all suggest that different modes of burial mound construction and grave placement may also have been employed at Kapiteljska njiva (*Fig. 2–4*; cf. *Fig. S1*).

Because the tumuli at Kapiteljska njiva were ploughed down and completely erased from the surface, their former extent can now be reconstructed primarily from the distribution of the grave pits, of which only the lower parts are preserved in the mineral B horizon. This situation substantially limits the possibilities for stratigraphic interpretation. At sites where the mound deposits and their stratigraphic relationship with grave pits are no longer preserved, it is generally difficult to determine reliably either the number of construction phases or the chronological relationship between the mound construction and individual graves, even when geoarchaeological methods are employed (cf. Križ 2019, Fig. 9; Prijatelj, Turniški, Grčman 2025).

B. Križ rightly emphasises that the depths reached by grave pits cannot in themselves serve as an indicator of the relative age of individual graves (Križ 2019, 36). In the context of the present discussion, this observation can be extended by considering the stratigraphic characteristics of graves within tumuli. In accordance with the principles of archaeological stratigraphy (Harris 1979; 1989), the relative dating of cuts depends not on comparing the depths reached by the bottoms of individual features, but on identifying and comparing the stratigraphic levels from which they were cut (*Fig. 6:* a). Identifying the level from which a grave pit was cut presents a particular problem in the stratigraphic analysis of tumuli, since this level is often not clearly discernible even when modern excavation methods are employed (e.g. Škoberne 1999, 29; Grahek 2025, 24). In documented sections, grave pits therefore often appear to 'float' within mound layers (e.g. Guštin, Preložnik 2005, Fig. 11: C; Tecco Hvala 2017, Fig. 27: B, 28), complicating their stratigraphic interpretation. Such a stratigraphic record can be explained by three hypothetical scenarios.

In the first scenario, the uppermost preserved level of the grave pit represents the original level from which it was cut into the mound fill. This would mean that the surface from which the grave was dug was not recognised in the documentation as a horizontal interface (*Fig. 6:* b). Such a situation could arise if the mound fill was first built up to a certain level, a grave was then cut into it, and the same material was subsequently deposited over the grave. In the second scenario, the level from which the grave was cut would coincide with the upper boundary of one of the mound layers, while the upper part of the grave fill would have

[11] In addition to the 69 tumuli discussed by Križ (2019), Tumuli A and B are also known from this area. They were excavated in 1894 and published by Knez (1993), although their precise location remains unclear (cf. Knez 1993, Fig. 25; Križ 2019, Add. 1).

become homogenised with the surrounding material over time through post-depositional, primarily pedogenic processes, particularly in the upper part of the mound (*Fig. 6:* c). In the third scenario, the stratigraphically 'floating graves' would not represent cuts at all. Instead, a deceased person would have been placed on a particular surface and covered by heaped soil. In this case, too, the surface on which the deceased was placed would not have been recognised in the documentation as a horizontal interface (*Fig. 6:* d; *7*).

The geometry of grave structures can help distinguish between graves cut into the substrate and graves formed by heaping soil over the deceased. Cut grave pits are generally rectangular or concave in section and narrow towards the bottom, whereas graves formed by heaped soil have a convex profile that narrows towards the top. A third type must also be considered: graves that were partly cut into the substrate and partly formed by heaping soil, combining the characteristics of both forms (Fig. 7). The second and third forms of grave construction have been identified in some Type 3a tumuli (*Fig. 7*; e.g. Guštin, Preložnik 2005, 123, Fig. 11; Gabrovec 2008, 13–17; Kruh 2008, 71).

The cases considered here (*Fig. 1; S1*) illustrate the importance of precise documentation of stratigraphic relationships. The reconstruction of different forms of burial mound construction (*Fig. 2–4*) and of the ways in which graves were incorporated into them (*Figs. 6–7*) depends on careful documentation of the geometry of mound fills and graves and of their stratigraphic relationships. Even in many tumuli excavated using modern methodology, interpretation is constrained by post-depositional pedogenic processes, partial or complete destruction of the mounds, and, in some cases, the selective publication of stratigraphic data.[12] The reliability of future interpretations could therefore benefit substantially from the systematic integration of geoarchaeological methods into the investigation of tumuli.

Despite these limitations, macroscopic stratigraphic observations and chronological evidence allow several general conclusions to be drawn. Whereas Type 1 tumuli were documented mainly among smaller mounds, Types 2 and 3 were identified among small, medium-sized, and large tumuli (*Fig. S1*). This suggests that these two modes of construction (*Fig. 3–4*) were probably not determined by mound size or related constructional decisions, but primarily by cultural conventions and funerary practices that changed over time within the territory of the Dolenjska Hallstatt group. In contrast to Type 1, the other two types also appear to show greater chronological specificity.

The earliest phase of the monumental Type 2 Tumulus I at Hrib in Metlika has been dated as early as the tenth century BC or the early Ha B[13] phase (Grahek 2004; 2014a). The small tumuli of the same type at Budinjak date to the beginning of the eighth century BC at the latest, or to the transition between Ha B2–3 and Ha C0 (Škoberne, Bugar 2017, 34; Škoberne 2004, 140–144, 20–21; cf. Teržan 2008, Fig. 42). This indicates that this mode of construction was already in use at the transition from the Late Bronze Age to the Early Iron Age. Monumental tumuli of this type at Magdalenska gora, for example Tumuli VI, VII, and 13 at Preloge (cf. Tecco Hvala 2012, 53–54, Fig. 16), show that this burial practice continued into the developed Hallstatt period in communities in which cremation burials remained more prominent (Tecco Hvala 2012, 79; cf. Grahek 2025, 104–106, 191, Add. 11: A).[14]

By contrast, Type 3a tumuli, characterised by complex funerary structures associated with central graves, a predominance of inhumation burials, and a strictly regulated arrangement of graves around the perimeter of the mound, date mainly from Ha C1 or the Stična phase onwards (e.g. Gabrovec 2008, 39, 40–43, 46; Gabrovec et al. 2006, Pls. 3–4; Kruh 2008, 69–71; Križ 2019, 254–255, 258–260, 262–265). They thus represent one of the characteristic forms of Dolenjska tumulus burial in the developed Hallstatt period.

In addition to the types presented here, other modes of burial mound construction and grave organisation can be expected within the territory of

[12] Among the published tumuli from Budinjak (Škoberne 1999; Škoberne, Bugar 2017), stratigraphic documentation has been published only for Tumulus 139 (Škoberne 1999, Fig. 9).

[13] In this paper, we follow the chronological scheme proposed by Teržan 2008 and the absolute dates given in Teržan and Črešnar (eds.) 2014.

[14] In many cases, particularly in older excavations, it is not possible to determine with certainty whether the earlier cremation graves were incorporated into smaller burial mounds or merely covered by later mound fill. Geoarchaeological methods should therefore be systematically incorporated into future studies of the development of tumulus cemeteries. Where the archaeological record is well preserved, such methods could help resolve this fundamental problem in the study of tumuli.

the Dolenjska Hallstatt group. A probable example is Tumulus III at Kapiteljska njiva, where a central group of cremation graves of the Urnfield culture is surrounded by a concentric series of inhumation graves dating from the Stična phase to the Negova helmet phase in LT A (Križ 2019, 258–260; Teržan 2020, 369–370, Fig. 3). Because the stratigraphic record has been destroyed, it remains unclear whether this represents a variant of a Type 3a, in which the tumulus covered earlier flat cremation graves, or a transitional form between Types 2 and 3, in which earlier cremation graves, each with their own small mound, were incorporated into a later, larger burial mound.

CONSTRUCTION MATERIALS

In previous research on tumuli of the Dolenjska Hallstatt group, construction materials have been identified solely on the basis of macroscopic observations made during excavation. In most publications, individual layers within the mound fill were described primarily on the basis of their colour (*Fig. S1*), and, in some cases, also by their texture and consistency (e.g. Udovč 2009; Tecco Hvala 2017). With the exception of Pezdirčeva njiva (Prijatelj, Turniški, Grčman 2025; see below), no site of the Dolenjska Hallstatt group has yet been subjected to systematic physico-chemical and micromorphological analyses of mound material. Since the discussion of construction materials is therefore based largely on stratigraphic data documented macroscopically (*Fig. S1*), the geoarchaeological interpretations proposed here remain hypothetical.

Macroscopic stratigraphic descriptions indicate that many tumuli were constructed using a single type of local, unconsolidated material (*Fig. S1*). This construction method is particularly characteristic of small and medium-sized Type 1 and Type 2 tumuli, including Tumulus 16 at Grmada near Molnik (Tecco Hvala 2017, 45–47, 82, Fig. 41), Tumulus 1 at Pleška hosta near Molnik (Tecco Hvala 2017, 67–78, Figs. 63–65), the tumulus at Mačkovec near Novo mesto (Udovč 2009, 10–11, Figs. 9–13), the tumulus at Grofove njive near Drnovo (Pavlovič 2014, 493, Fig. 28.3; Tica 2022, 22–24, Fig. 20, 22–24), and probably also several smaller tumuli at Budinjak.[15]

The Mačkovec tumulus illustrates the interpretative limitations of macroscopic layer descriptions. Within its mound fill, two layers were documented between the modern turf (SE 001) and the sterile geological substrate (SE 006) with limestone rocks (SE 005). Immediately beneath the turf lay a firm brown silty clay (SE 002), 0.36–0.50 m thick and without archaeological finds. Below it was a firm, greasy, yellowish-brown clay (SE 004), 0.35–0.50 m thick, in which graves and pottery fragments were discovered. The excavators interpreted layer SE 004 as the mound fill and the overlying layer SE 002 as its upper part (Udovč 2009, 10–11, Figs. 12, 13).

On the basis of the macroscopic evidence, it is not possible to determine reliably whether layers SE 004 and SE 002 represent two separate construction phases or whether the upper layer resulted from the later transformation of the original mound fill. As elements of surface relief, burial mounds are affected by a range of sedimentary processes that may remove material from or add it to the mound surface, while vertically oriented pedogenic processes simultaneously alter the properties of the material within the mounds themselves, particularly in their upper parts (cf. Hejcman et al. 2013; Kabała et al. 2019). Whereas agricultural land use causes erosion and lowering of the mounds, colluvial processes or long-term grassland use may also contribute to the formation of a thickened cumulative A horizon in the upper part of the mound fill.

On the basis of the available evidence, we hypothesise that layer SE 002 does not represent a second mound fill, but rather the upper part of the original mound transformed by pedogenic and sedimentary processes. This interpretation is supported by the position of the tumulus on undulating relief (Udovč 2009, 6, Figs. 3, 6, 7), historically attested grassland use (Udovč 2009, Fig. 4), and the diffuse transition between the modern turf (SE 001) and layer SE 002, in which a dense root system was documented (Udovč 2009, 10, Figs. 12, 13). If our interpretation is correct, the Mačkovec tumulus was constructed from a single type of material, the upper part of which

[15] In his discussion of burial types at the site, Ž. Škoberne (1999, 18–30) specifies in Fn. 46 that the tumuli were constructed from two types of local soil material: yellow soil without a coarse fraction (i.e. without rock and mineral particles larger than 2 mm), mixed with loam, and red soil (loam) containing a coarse fraction. Both types of soil material were documented in B horizons at the site; however, with the exception of Tumulus 139, Škoberne (1999, 43–44, Fig. 27) does not present the stratigraphy of individual tumuli.

was substantially transformed by post-depositional pedogenic and sedimentary processes. At the same time, this case demonstrates that layers defined macroscopically within a tumulus do not necessarily represent separate construction phases, but may instead result from later soil development.

A second pattern of construction-material use occurs in tumuli whose macroscopic stratigraphic descriptions indicate the use of two different types of material (*Fig. S1*). This construction method is characteristic mainly of medium-sized and large Type 2 and Type 3 tumuli, including Tumulus 13 at Grmada near Molnik (Škvor Jernejčič 2017, 91; Tecco Hvala 2017, 34–44, 82, Figs. 26–27, 83); Tumulus 48 at Stična (Gabrovec et al. 2006, Adds. 1–2; Gabrovec 2008, 39, 40–43, 46; Teržan 2024, 130–132, Figs. 5–8); Tumulus 10 at Velike Malence (Guštin 1996, 119, Fig. 3); Tumulus 139 at Budinjak (Škoberne 1999, 43–107, Figs. 26–27; Škoberne, Bugar 2017, 67–72); and Tumulus I at Hrib in Metlika (Križ 1988; 1990a, 1990b; Grahek 2004, 118–120, Figs. 11, 13–15, Adds. 1–4).

In several cases, macroscopic descriptions indicate pronounced differences between darker layers, probably richer in organic matter, and lighter mineral layers. For example, a lower, darker fill and an upper, lighter fill were described in Tumulus 10 at Velike Malence (Guštin 1996, 119, Fig. 3) and the large Tumulus I at Hrib in Metlika (Grahek 2004, 118). These descriptions suggest that material from former humus-accumulative A horizons may have been used for the initial mound fill, while material used for later enlargement of the burial mound may have been obtained from subsurface mineral horizons. Owing to its lower organic-matter content and higher proportions of clay minerals and iron and aluminium oxides, such material would generally be expected to be lighter in colour, ranging from yellow to red (cf. Guštin 1996, 119, Fig. 3; Grahek 2004, 118). If the proposed interpretation of the source of the material is correct, the use of soils from mineral horizons may also reflect a deliberate constructional choice. Materials with a higher clay content have better cohesive properties and may therefore have contributed to the greater stability of large earthen structures (cf. Papadopoulos, Bejko, Morris 2008; Gkouma, Karkanas, Iacovou 2021).

A particular variant of construction using two types of material is represented by the large Tumulus 48 at Stična (Gabrovec et al. 2006, Adds. 1–2; Gabrovec 2008, 39, 40–43, 46; Teržan 2024, 130–132, Figs. 5–8). In *sections E*[16] and *G*, at least six successive fills were documented and described as yellowish-grey layers (Gabrovec et al. 2006, Add. 2),[17] most likely indicating the repeated use of similar mineral material over several construction phases. Horizontally oriented light-grey lenses were also documented within the stone ring (*Fig. 7*).[18]

Macroscopic documentation alone does not permit a reliable interpretation of these structures. Their form and arrangement, however, resemble the stratigraphy of Tumulus 28 at Poštela below Habakuk, where micromorphological analysis showed that a similar alternation of grey and yellow layers represents stacked sod blocks (Prijatelj et al. 2025). We therefore hypothesise that turf may also have been used in the latest phase of Tumulus 48 at Stična. The sod blocks within the stone ring may have been stacked to form a low vertical wall or used as an additional structural support to prevent slippage and subsiding of material in the monumental mound (*Fig. 7*; cf. Borisov et al. 2019, 128, Fig. 6).

The possible use of turf in the construction of tumuli of the Dolenjska Hallstatt group has not previously been examined systematically. Teržan (2024, 130–132, Figs. 5–8) drew attention to its possible presence in the large Tumulus 48 on the basis of archival section drawings and photographs from 1946 and 1962, as well as comparisons with the stratigraphy of Scythian kurgans. She proposed that the earliest fill above central Grave 19–21 was constructed from turf. Although grey, horizontally oriented lenses were not documented in the earliest fill in the monographic publication (cf. Gabrovec et al. 2006, Add. 2), archival photographs and section drawings (*Fig. 8*; Teržan 2024, Figs. 5–8) indicate that at least some segments of the mound were probably indeed built using sod blocks.

[16] Since both soil horizons and some tumulus profiles are designated by letters, italics are used for archaeological profiles to facilitate distinction between the two types of data.

[17] In his description of Tumulus 48, Gabrovec (2008, 39, 40–43, 46) distinguishes only four fills: the earliest mound fill, which covers central Grave 19–22, and three later fills. By contrast, *profiles E* and *G* clearly show a greater number of layers within the tumulus. Beneath the brown layer, at least six layers of mound fill can be distinguished in the southern part of *section E* and in *section G* (cf. Fig. 7; Gabrovec et al. 2006, Add. 2).

[18] In the southern part of the published profile (Gabrovec et al. 2006, Add. 2), the uppermost fill is, in our view, incorrectly identified as a brownish subhumic layer. Our proposed correction is indicated here by a lighter shade of the fill.

In the photographs (*Fig. 8*; see also Teržan 2024, Figs. 6–8), a darker-coloured contact is visible between the presumed sod blocks and the soil deposited over them. One possible explanation is the formation of iron–manganese concretions or crusts, which commonly develop at the boundary between materials of differing permeability and under contrasting redox conditions.[19] Similar pedogenic features have been documented in Early Bronze Age turf burial mounds in Denmark, where deliberate wetting of the mound core caused iron concretions to form at the boundary between its anoxic[20] interior and the better-aerated outer mound fill. The resulting concretions sealed the mound core and enabled the exceptional preservation of wooden coffins and, in the case of the Egtved Storhøj burial mound, even the body and clothing of the deceased girl (e.g. Breuning-Madsen, Holst 1998; Breuning-Madsen, Rønsbo, Holst 2000; Holst, Breuning-Madsen, Rasmussen 2001).

A further significant stratigraphic detail also points to the possible use of turf in the construction of the large Tumulus 48 at Stična. Beneath the earliest fill covering central Grave 19–22, control sections revealed a dark-grey layer approximately 10–50 cm thick, passing downwards into a yellow layer from which the bedrock locally protrudes (*Fig. 7*; see also Gabrovec et al. 2008, Add. 2). This sequence can be interpreted as the buried organo-mineral (A) and mineral (E or B) horizons of the natural soil present at the site when the earliest mound was constructed. Since the buried A horizon in *section E* was preserved only beneath the earliest fill and not beneath the later mound extensions (*Fig. 7*; see also Gabrovec et al. 2008, Add. 2), one possible explanation is that turf was stripped from the immediate vicinity of the tumulus and used as construction material (cf. Borisov et al. 2019, 128, Fig. 6).

The deliberate removal of turf at the site raises the question of how the area within the stone ring was managed. It is possible that the ground between the ring and the mound fill was deliberately maintained at the level of the yellowish mineral subsurface horizons (cf. Parzinger 2017, 334, Fig. 2). In that case, the combination of white stone in the ring, light-coloured mineral soil without vegetation, and a mound probably covered with grass would have created a striking visual contrast that may have carried both practical and symbolic significance.

The effect of pedogenic processes on the stratigraphy of Tumulus 48 is reflected in thin light-grey layers visible at the boundaries between the individual yellowish-grey fills added as the mound was gradually enlarged from the eighth to the early fifth century BC (*Fig. 7*; see also Gabrovec et al. 2008, Add. 2). These layers may represent the initial development of an A horizon on the mound surface during intervals between construction episodes, when a hiatus in sediment deposition and surface stabilisation allowed more intensive pedogenic processes to occur. A similar stratigraphic situation is found in Tumulus 139 at Budinjak, where a thin, loose brown layer between the first and second fills may likewise reflect the development of an A horizon on the older mound surface prior to the next phase of enlargement (Škoberne 1999, 43–107, Figs. 26–27).

A third construction pattern occurs in tumuli whose macroscopic descriptions indicate the use of three or more types of material (*Fig. S1*). These are mainly small and medium-sized Type 2 and Type 3 tumuli, for example Tumulus 17 at Grmada near Molnik (Tecco Hvala 2017, 48–60, 82, Figs. 44–45, 83; Škvor Jernejčič 2017, 93); Tumulus 5 at Stična (Gabrovec et al. 2006, Adds. 3–4; Kruh 2008, 69–71); and Tumulus 9 at Sajevce near Kostanjevica (Guštin, Preložnik 2005, 121–130, Fig. 11).

The stratigraphy of Tumulus 5 at Stična is particularly informative. Several types of soil were described macroscopically: a layer of grey-yellow clay used to level the surface; a thinner layer of orange-red soil above it, perhaps used to complete the levelling;[21] reddish-brown soil forming the earliest mound fill above the central grave with its stone construction; and a later brown layer thought to be associated with the second phase of mound enlargement. Grey-yellow lenses were also documented within the mound and may represent

[19] Redox conditions in soils are closely related to soil aeration and may range from oxidising to reducing or anoxic conditions.

[20] Anoxic or anaerobic conditions in soils (i.e. the complete absence of oxygen) occur when soil pores are fully saturated with water and the concentration of dissolved oxygen in the pore water is effectively zero. Under such conditions, all aerobic processes cease and microorganisms shift their metabolism to anaerobic redox processes. Such conditions are characteristic primarily of water-saturated and/or very organic-rich soils.

[21] Although documented in the profile (cf. Gabrovec et al. 2008, Add. 4), A. Kruh (2008, 70–71) does not discuss this layer.

additional fills (Gabrovec et al. 2006, Adds. 3–4; Kruh 2008, 69–71).

Without geoarchaeological analyses of the materials described above, it is difficult to distinguish between layers resulting from the use of different construction materials and those formed through later pedogenic modification of the mound deposits. As in the Mačkovec tumulus (Udovč 2009), the upper brown material may have developed through pedogenic transformation of the original mound fill. Similarly, it remains unclear whether the individual grey-yellow lenses represent additional fills (cf. Gabrovec et al. 2006, Add. 4) or local pedogenic changes within the reddish-brown soil of the first fill.

Nevertheless, the macroscopic evidence indicates that in some Type 3 tumuli particular attention was paid to preparing the surface on which the funerary structure of the central grave was erected (see also Škoberne 1999, 43–107, Figs. 26–27). The use of different soils, especially reddish-coloured ones, in preparing the base – as in Tumulus 5 at Stična and Tumulus 139 at Budinjak – could reflect either the pragmatic use of locally available materials or their deliberate selection. Without micromorphological, pedological, and geochemical analyses, however, the provenance and properties of these materials cannot be established reliably, limiting any assessment of the reasons for their selection and their possible symbolic significance. The same applies to organic materials that may have been incorporated into mound construction or grave furnishings. Their presence is often not recognisable in the macroscopic stratigraphic record and may therefore be identified and investigated primarily through micromorphological, geochemical, and biomolecular methods (e.g. Sulas et al. 2022).

The examples considered here demonstrate that macroscopically described layers do not necessarily correspond to individual construction phases. Some of the observed differences may reflect later pedogenic and sedimentary processes that altered the original properties of the material after the burial mounds were constructed (cf. Hejcman et al. 2013; Kabała et al. 2019). Without geoarchaeological analyses, it is therefore often impossible to distinguish reliably between primary construction layers and secondary transformations of the mound fill. The comparative analysis indicates three basic patterns in the use of construction materials: construction from a single type of soil, the combination of two different types of material, and the use of several different materials in successive construction phases. In some tumuli, turf may also have been employed. These patterns broadly correspond to the proposed models of burial mound construction (*Fig. 2–4*). Type 1 tumuli generally appear to have been constructed from relatively uniform material, whereas Types 2 and 3 more frequently show the use of different materials associated with successive phases of mound construction and enlargement.

PEZDIRČEVA NJIVA – AN EXAMPLE OF GEOARCHAEOLOGICAL METHODS IN TUMULI RESEARCH

Pezdirčeva njiva is an extensive Iron Age cemetery on the slope of Kučar near Podzemelj. The hilltop settlement was occupied from the 9th to the end of the 1st century BC (Grahek, Kovač 2020, 441–446, 450), while the cemetery was in use during the Late Hallstatt and La Tène periods (Grahek 2025, 189–196). Between 2017 and 2021, 182 graves were excavated, of which only the lower portions were preserved within the mineral B horizons, with no visible remains of mound fills (Grahek 2025, 103–139).

The geoarchaeological investigation of Pezdirčeva njiva addressed two fundamental methodological questions. First, how can destroyed mounds be identified in areas where no topographic or stratigraphic traces of mound deposits have survived? Second, can the available data be used to reconstruct soil development at the site and assess the impact of natural pedo-sedimentary processes on the archaeological record? To address these questions, geoarchaeological investigations were carried out on four profiles within the cemetery (P1–P4) and two control profiles outside it (P5–P6) (*Fig. 9*). The analyses included pedological descriptions, laboratory determinations of texture, pH, carbonates, organic matter, C/N ratio, cation exchange capacity, base saturation of the soil exchange complex, micromorphological analysis, and geomorphological analysis of five slope elements (Prijatelj, Turniški, Grčman 2025).

Comparison of the results showed that profiles P2 and P3, located within presumed tumuli, differ from the natural profiles in having an increased clay fraction in the surface soil horizons. This textural signal was interpreted as a remnant of eroded mound fill constructed from mineral, clay-rich soil material that had gradually become mixed with

the ploughsoil through long-term agricultural use (Prijatelj, Turniški, Grčman 2025). On this basis, a model of the erosion and lateral redistribution of mound material through long-term ploughing was developed (*Fig. 10*), explaining why its textural signal may remain partly preserved in the surface soil horizons even after the mounds have completely disappeared from the surface relief.

Another important result of the study was the distinction between naturally and anthropogenically buried soils. In profile P3, an A horizon preserved beneath one of the presumed tumuli was interpreted as having been buried during mound construction. By contrast, the buried A horizon in profile P1, in the area of the La Tène flat graves, resulted from later colluvial deposition (Prijatelj, Turniški, Grčman 2025). The two types of buried soil could be distinguished only by integrating pedostratigraphic, laboratory, and archaeological data.

The entire sequence of natural and anthropogenic processes was summarised in a conceptual model of soil development at the site (*Fig. 11*). The model presents four main developmental phases: 0 – the formation of natural soils on re-sedimented material during the Holocene; 1 – anthropogenic modification of the landscape through the construction of burial mounds in the Late Hallstatt period; 2 – the burial of soils in the cemetery by colluvial material during Antiquity or later; and 3 – long-term agricultural use in the modern period, during which the mound fills were gradually eroded and incorporated into the ploughsoil (Prijatelj, Turniški, Grčman 2025; Prijatelj, Grčman 2025).

The Pezdirčeva njiva case study thus demonstrates that the macroscopic observation of stratigraphy alone is often insufficient for reconstructing the full range of natural and anthropogenic processes affecting areas of eroded mounds. Integrating archaeological observations with geoarchaeological methods can help distinguish between natural pedogenic processes, colluvial sedimentation, remnants of mound fills, and anthropogenically buried soils. Geoarchaeological analyses therefore provide an important complement to stratigraphic investigations of tumuli, particularly at sites where long-term land use has completely erased the mounds from the surface relief (Prijatelj, Turniški, Grčman 2025).

CONCLUSION

Based on a critical comparative analysis of published stratigraphic documentation from 11 cemeteries, this paper has presented theoretical models of burial mound construction within the Dolenjska Hallstatt group (*Fig. 2–7*). In many cases, the available documentation contains evidence that can be reinterpreted from a geoarchaeological perspective, particularly with regard to the identification of construction phases and buried soils, the possible use of turf, and the effects of soil-forming processes on the preservation of the stratigraphic record. The proposed models and geoarchaeological reinterpretations should be regarded as research hypotheses that can be tested through the systematic integration of modern geoarchaeological methods into future research on tumuli.

The models presented show that tumuli differed both in their methods of construction and in the ways graves were incorporated into the mound fill. The preserved stratigraphic record was also substantially modified by post-depositional pedogenic and sedimentary processes, which in some cases probably resulted in the formation of layers of non-anthropogenic origin. The comparative analysis of construction materials identified three basic modes of burial mound construction: the use of a single type of soil material, the combination of two types of material, and multi-phase construction employing several different materials. Turf also appears to have been used in some tumuli of the Dolenjska Hallstatt group.

The potential of a geoarchaeological approach is illustrated by the Pezdirčeva njiva case study, based on previously published research (Prijatelj, Grčman 2025; Prijatelj, Turniški, Grčman 2025). At this site, the combination of geomorphological, pedological, and micromorphological analyses made it possible to identify completely eroded mounds, distinguish between anthropogenically and naturally buried soils, and reconstruct the key pedo-sedimentary processes that affected the preservation of the archaeological record. The case study demonstrates that geoarchaeological methods can substantially complement conventional stratigraphic analysis at sites where above-ground structures are no longer preserved.

The results presented here demonstrate the importance of systematically integrating geoarchaeological analyses into future research on tumulus cemeteries. In the case of eroded mounds, profiles should be sampled systematically across the mound area,

both within and outside grave pits, together with profiles in the cemetery beyond the mounds and control profiles of natural soils outside the cemetery (*Fig. 12:* a). In preserved tumuli, all mound layers and grave-pit fills should be sampled systematically, together with buried soils beneath individual fills (*Fig. 12:* b). The latter are particularly important, as they enable the reconstruction of changing palaeoenvironmental conditions through time and the assessment of post-depositional processes affecting material within the mound. Equally important is the sampling of naturally buried soils within the cemetery, which allows natural sedimentary processes to be distinguished from anthropogenic interventions in the landscape.

The proposed research framework integrates stratigraphic analysis and geoarchaeological methods into a unified methodological approach. Such integration not only enables more reliable identification of construction materials, building techniques, and post-depositional processes, but also facilitates the long-term development of a regional database containing comparable geoarchaeological data on prehistoric tumuli. This, in turn, would provide a basis for broader comparative geoarchaeological studies of tumuli in the region.

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