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□ Necrosol as a Material Archive of Genocide: The Case of the Nazi German Mass Crimes in the Szpęgawsk Forest

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Abstract

The first months of World War II in Gdańsk Pomerania saw the mass murder of local intellectual elites, of people with mental disorders or disabilities and of representatives of the small Jewish community. The Germans usually hid the victims' bodies in mass

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graves. About 30 places of execution from this “bloody autumn of 1939” were destroyed in the second half of 1944, as part of Aktion 1005, an operation to conceal evidence of the crimes. In this paper, we present the historical context for the characteristics of the necrosol from one mass grave in the Szpęgawsk Forest, which was destroyed/desecrated by the Germans at the end of 1944. The research proves that even the destruction of mass graves by exhuming the bodies and burning them leaves material traces that allow for the reconstruction of the organisation of the crime and the methods of covering it up.

Introduction

Necrosol is an anthropogenic soil type familiar to archaeologists working on exhumations (Domańska 2017). It is characterised by bone material in the mineral substrate, and a particular chemical composition arising from processes of decomposition of the human body; it may also contain ecofacts, as well as artefacts such as the remains of personal items belonging to the deceased. In this way, the soil of burial grounds is a mineralised form of memory of the past – and in the case of mass graves associated with executions and with concentration and extermination camps it is a material archive that can be analysed in the context of war crimes and attempts to cover them up (e.g., Holliday and Gartner 2007; Amuno and Amuno 2014a, 2014b; Majgier *et al.* 2014; Charzyński *et al.* 2015). The scientific and archaeological exploration of necrosol may reveal information not only about the organisation and course of war crimes, but in some cases may also establish the identities of victims (Kobińska 2022, 2023b). Such research belongs to a dynamically growing “forensic turn” within the humanities and social sciences, seen particularly in anthropology and archaeology (e.g., Ferrándiz and Robben 2015; Groen *et al.* 2015; Moran and Gold 2019; Staniewska and Domańska 2023). This approach also informs Holocaust and genocide studies (Dziuban 2017), and in Poland it has been applied to the study of the post-war communist terror (e.g., Ławrynowicz and Żelazko 2015). A related context is a broader “geological turn” (Bonneuil 2015), in which disciplines such as history, archaeology and anthropology have begun examining the multifaceted environmental impacts of anthropogenic pressures.

This article is concerned with the material records of the Pomeranian Crime of 1939, the Nazi genocide committed against citizens of the Second Polish Republic in the first months of World War II in Gdańsk Pomerania, Poland. The main focus is a case study of the necrosol of a mass grave that was examined in 2023 in the Szpęgawsk Forest as part of the project “Archaeology of the Pomeranian Crime of 1939” (Kobińska *et al.* 2024). The grave itself was destroyed in the autumn of 1944, when the bodies of the victims were exhumed and then burned. The research is the first study of a necrosol related to the Pomeranian Crime of 1939, the examined soil being a specific category of the material archive (Figure 1). Parallel to this archive is the visual documentation of the work process and the soil itself (see also Kobińska 2023b, 2024).

Theorising Soil: The Pomeranian Genocide Context

In recent years, the term *Anthropocene* has permeated into humanities discourse from geology, climatology and soil sciences. The notion of the Anthropocene, defined as a

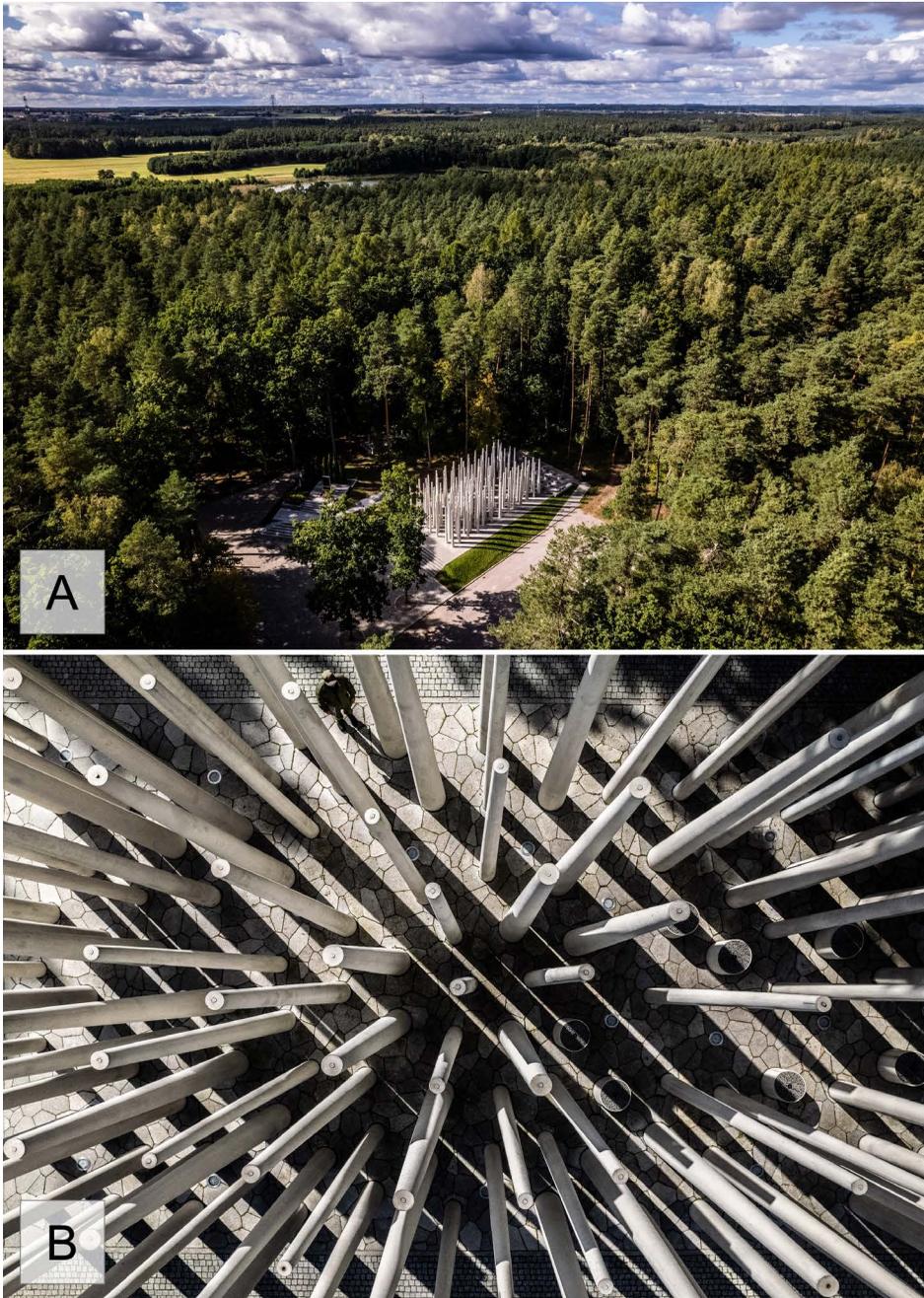


FIGURE 1. Szpęgawsk Forest. A: bird's eye view of the main commemoration area and the surrounding forests, which were the place of execution of thousands of citizens of the Second Polish Republic murdered in the autumn of 1939; B: bird's eye view of the main commemoration area in the Szpęgawsk Forest (image by D. Frymark).

human-caused geological event that is not yet a formal epoch (Gibbard *et al.* 2022), shifts attention to various forms of ecological disturbances that affect the stratigraphy as well as the biological and chemical content of soils; these can be natural disasters or anthropogenic catastrophes including wars and war crimes committed on a massive scale. Environmental historians and ethicists have presented many detailed studies that reveal a genocide–ecocide nexus (Crook and Short 2022) and that pinpoint its importance for interpreting the post-disaster and post-conflict landscapes of the twentieth- and twenty-first-centuries (Eichler 2020). This includes ecologically oriented themes such as symbiogenetic destruction (Woolford *et al.* 2021) and the environmental history of mass graves (Domańska 2020).

At a time when the generations that can remember the horrors of World War II and the Nazi atrocities are passing away, various researchers have proposed a shift away from oral or written testimonies as the primary source of historical knowledge and embodied experience of the wartime past, towards other figurations of evidence. These include concepts such as material evidence or material witness (Schuppli 2020; see also Grzybowska *et al.* 2019), and nonhuman witnesses (Małczyński 2009; Smykowski 2017, 2019). Interest in materiality in this broad sense involves a thorough analysis of the aftermath of war crimes, including the heritage of mass killing sites: victims' belongings deposited in the ground; dead bodies and dispersed incinerated human remains; the soil itself; traces of crime concealment by the perpetrators; unusual landmarks and ecological disturbances; vegetation over mass graves; and the complex ecological–material entanglements of various objects connected to extermination procedures. Mass graves and their surroundings might be considered a specific form of environmental archive (Turkel 2006) that accumulates material objects mingled with organic and inorganic matter, creating new hybrid sources of knowledge about the violent past.

For this reason, forensic scientists argue that the term “crime scene” may often be inadequate. In many post-genocide investigations – such as those relating to the Holocaust, Srebrenica or Rwanda – the sites where the atrocities took place have been hard to identify precisely, or there are simply too many of them spread over relatively large areas (Anstett and Dreyfus 2017). Also, bodies were often moved from execution sites to temporary deposition/inhumation sites, and then in many cases exhumed, incinerated and reburied in different locations, additionally covered by site-specific species of flora as a form of camouflage (e.g., Jugo and Wastell 2015). As such, a broader perspective is required, as encapsulated by the notion of “forensic landscape” (Cox *et al.* 2008; Cyr 2014). This term acknowledges that a forensic and archaeological investigation must include an analysis of environmental conditions, such as the local topography: to establish the possible scenarios all disturbances in the stratigraphy of mass graves and their surface surroundings should be noted, and the dynamics of the landscape itself (including vegetation cycles and species composition). Details may also point towards the identification of clandestine graves (e.g., hidden in woodland).

Forest areas in particular bear witness to mass killings committed during World War II in the territories of east-central Europe occupied by Nazi Germany, and this is the case with the Pomeranian Crime of 1939: primarily the Szpęgawsk Forest, the Piaśnica Forest and, in case of the extermination of Jews, the Rzuchowski Forest. In the post-war period,

sites in Poland were investigated by the Chief Commission for the Prosecution of Crimes Against the Polish Nation, which had the difficult task of identifying the victims and – particularly challenging – estimating the number of the deceased, based on evidence that included not only human remains in various conditions and states of preservation, but also the by-products of the extemporaneous and improvised cruel and violent processes used to get rid of the evidence (a necroicide – Domańska 2017). The physical and biochemical processes that accompanied these procedures of extermination and subsequent attempts to cover up the crime have given the Szpęgawsk Forest a new ontological status as an ecosystem ingrown into the necrosol (for a detailed account of a comparable process in the Rzuchowski Forest, see Smykowski 2018).

The soil contained in mass graves, of course, is not just a soil: it consists of various mineral textures and fragments, and varying levels of organic matter, including bone, mixed with material objects belonging to the victims. The term “necrosol” for this type of compound comes from the field of taphonomy (Sobočka 2004; Majgier and Rahmanov 2012; Majgier *et al.* 2014), to refer to a specific type of anthropogenic soil characteristic of areas where a large number of dead bodies are concentrated underground: burial necrosols comprise disturbed stratigraphy of the soil horizon sequence, and altered biological and chemical properties such as higher levels of phosphorus, nitrogen and organic carbon. The specific characteristics of a necrosol at mass burial sites are determined by the amount of human and artefactual remains deposited (Majgier and Rahmanov 2012).

Sites of remembrance established *in situ* and memorial narratives in honour of the fallen objectify the atrocities and enable mourning practices for victims’ families and descendant generations, while excavated material objects made into museum exhibits tell individual stories and extend the history of the crime *sensu largo*. Exhumed objects, which Domańska (2023) terms *exhumates*, can be considered part of the material culture of mass graves. The nature-cultural assemblage represented by the conglomerate of necrosol, artefacts and human remains (Kobiąłka 2024) can therefore be interpreted as a material-ecological heritage that confirms that the mass killings during the Pomeranian Crime of 1939 changed not only the local social structure, but also the development of the local forest ecosystem, including soil specificity and local biodiversity. The history of the Pomeranian Crime in Szpęgawsk is clear proof of such a thesis.

The Pomeranian Crime of 1939 and Archaeology

The Polish phrase *centrum ciemności*, meaning *heart of darkness*, is a particular phrase used by Machcewicz (2016) in the catalogue for the permanent exhibition of the Museum of World War II in Gdańsk to describe the first months of World War II in Gdańsk Pomerania and the nature of the German policy. This policy had several components aimed at intimidating the Polish population living in the area quickly and effectively against possible insurgent activities. Aspects of this policy have been studied by subsequent generations of Polish historians (e.g., Steyer 1967; Madajczyk 1970; Bojarska 1972; Jastrzębski 1974; Jastrzębski and Sziling 1979; Wardzyńska 2009); however, the key element of the *heart of darkness* was the physical – as it was commonly and euphemistically referred to – *elimination* or *evacuation* of selected categories of citizens of the Second Polish Republic.

The scale of the crime is impossible to estimate precisely. Executions usually took place in remote and inaccessible places (primarily forests), to prevent them from being witnessed. The bodies of the victims were almost always hidden in either individual, collective or, most usually, mass graves. The command of the Selbstschutz (Mazanowska and Ceran 2016; Mazanowska 2017), the organisation responsible for most of the shootings in the autumn of 1939 in so-called “Greater Pomerania”, was aware of the possibility of prosecution for these acts (sooner or later), and soon afterwards destroyed its records in a fake car accident. Later, in the second half of 1944, a special exhumation commando operated intensively in Gdańsk Pomerania with the aim of finding the mass graves from autumn 1939, exhuming the bodies and then burning them, making it impossible to estimate the scale of the crime or to identify the victims. These activities were given the code name Aktion 1005 (Hoffmann 2013).

At the end of the 1960s and early 1970s, the first synthetic, rather than contributory, studies of German crimes in Gdańsk Pomerania in autumn 1939 appeared. At that time, researchers assessed that between September and December the Germans may have murdered 50,000–60,000 people. Contemporary estimates are more conservative and oscillate around 30,000–35,000 victims (Ceran *et al.* 2018); these lower figures, though, are bare minimums. Further, for several of the largest execution sites in Gdańsk Pomerania exterminations took place until January 1940, or even up to April.

The extermination of citizens of the Second Polish Republic in Gdańsk Pomerania primarily involved several social and religious groups. The subscription lists prepared before 1 September, 1939 mostly comprise members of the intelligentsia, the “leading layer” of the Polish nation as they were sometimes referred to by the officers of the Third Reich: teachers, clergy, politicians, social activists, etc. Additionally, however, hundreds or even thousands of people with mental disorders or disabilities from Pomeranian psychiatric hospitals – or even transported from the depths of the Third Reich, as in the case of the Piaśnica Forest crime (Bojarska 2009) – were executed at the same location. The third characteristic group was representatives of the Jewish community, which in Gdańsk Pomerania constituted just over 2% of the region’s population (Ceran *et al.* 2018). Further, almost anyone who had had contact with the local German minority in one way or another during the interwar period or after 1 September, 1939 may have been targeted: the mere desire to take over land, an apartment, a brewery, etc., were, according to post-war witness testimonies, reasons for sending these Poles to the death pits. There are also documented instances where individuals were taken to places of mass execution simply because they had made an indiscreet joke about Hitler or Göring, etc. Considering the scale of the crimes, their specificity to Gdańsk Pomerania and the group of torturers associated with the infamous Selbstschutz, a group of Polish historians of the younger generation coined the term “Pomeranian Crime of 1939” to conceptualise all the crimes committed in this area in a given time period by selected groups of officers of the Third Reich, as well as the methods used to cover up traces of the crimes – both at the time and in the second half of 1944 (Ceran *et al.* 2018).

Exhumations were carried out by the Commission at most of the execution sites related to the crime after the war. However, the project “Archaeology of the Pomeranian Crime of 1939” is the first scientific attempt to use modern methods and tools of archaeological

research to look again at the criminal acts, their material heritage (record) and the process of erasing traces, as well as at contemporary memory of these events. A multidisciplinary perspective (e.g., Kobińska 2023a, 2023b; Kobińska *et al.* 2024; Smykowski and Kobińska 2023) has opened up new possibilities, by redefining the status of certain categories of discovered material as evidence (the work is being carried out under the authority of the prosecutor's office of the Institute of National Remembrance in Gdańsk) and facilitating intersections and interactions between science, investigation and art (see also Kobińska 2023b) (Figure 2). This article is an example of this, in which the visual documentation of the research process in the Szpęgawsk Forest and the necrosol from one of the mass graves examined there in 2023 constitutes the basis for analysis and reflection.



FIGURE 2. Metal detector survey was an important component of the adopted project methodology. A: one of the volunteers during work; B: a pistol casing found near one of the marked mass graves in the Szpęgawsk Forest (image by D. Frymark).

The Pomeranian Crime of 1939 as Genocide

To properly understand the essence of historical phenomena, it is important to find the right name and term. In 1945, when the search for, exhumation and identification of the bodies of the victims of German terror in formerly German-occupied Poland was just beginning, the poet Wisława Szymborska, then aged 22, published her first poem, with the evocative title *Szukam Słowa* (*I'm Looking for a Word*). Her aim was to find a word that would “contain every mass grave” (*pomieści każdą mogiłę zbiorową*) and “better describe everything that happened” (*lepiej opisze wszystko co się stało*) (Szymborska 2023: 12–13). The future Nobel Laureate in Literature did not find such a word, but like many Polish writers she felt the need to create such a concept.

Already during the war, however, there was a person who, not in the language of poetry, but first of history and then of international law, gave a name to what had happened in German-occupied Poland and throughout Europe. This was Rafał Lemkin, a Polish lawyer of Jewish origin (Ceran 2024, 25–27). In 1944, observing what was happening in the countries occupied by the Germans, particularly Poland, Lemkin concluded that

[n]ew conceptions require new terms. By “genocide” we mean the destruction of a nation or of an ethnic group. This new word, coined by the author to denote an old practice in its modern development, is made of the ancient Greek word *genos* (race, tribe) and the Latin *cide* (killing)” [...].

(Lemkin 1944, 79)

Lemkin explained that genocide is not a single act, but a coordinated plan encompassing various activities. Existing concepts, such as denationalisation or Germanisation, were inadequate: such terms implied imposing the cultural patterns of the occupying nation on the representatives of the occupied nation, but it was assumed that the population would remain alive. At that time, Lemkin did not know the extraordinary scale of German crimes in Pomerania at the beginning of the occupation, but he did know that Germany had resorted to extermination as one of the tools of its occupation policy (Madajczyk 2024).

The Polish jurist distinguished eight genocidal techniques: cultural, social, political, economic, biological, physical, religious and moral genocide (Lemkin 1944, 82–90). They aimed at the disintegration of political, social and cultural institutions, and the destruction of national language, religion, economic basis, personal security, freedom, health and, finally, national and cultural feelings. Lemkin’s list is not hierarchical, and he did not identify any one of them as necessary to the definition. However, it is reasonable to infer that physical genocide was the most important for him, and the main reason for his search for a new concept. The Pomeranian Crime of 1939 was first and foremost a physical genocide in the strict sense – taking the lives of part of a national group that was essential to its functioning as a national community. For Lemkin, it was not necessary for all or even most members of a group to be exterminated for there to be genocide: “Severe brain damage paralyses the strength and existence of the entire body” (quoted in Madajczyk 2024: 216). The goal of German policy in occupied Poland was the annihilation of the Polish nation – which may or may not have meant the murder of all its representatives.

Additionally, the historian Robert Melson (1992, 22–30), drawing on the definition of genocide at the 1948 UN Convention, has distinguished partial genocide from total

genocide. The aim of the former is not to exterminate an entire social group, but only various aspects of it, so degrading its status and identity. Examples of partial genocide include the extermination of Poles and Russians during World War II – in the former case, starting with the incident discussed in this paper, the extermination of Polish elites in 1939 in Gdańsk Pomerania.

Necrosol as a Material Archive of Genocide: The Case of Szpęgawsk Forest

The Szpęgawsk Forest was one of the three largest execution sites in Gdańsk Pomerania in 1939 (Milewski 1989; Kubicki 2019), involving mass crimes against the local intellectual elites, people with mental disorders and disabilities (women, men and children) from the psychiatric hospital in Kocborowo, its branches and other hospitals, and most likely representatives of the Jewish community (here, post-war eyewitness accounts are ambiguous). A monograph on the subject by Kubicki (2019) gives a minimum number of 2413 victims, identified by name and the circumstances of their detention (or execution). Post-war estimates, however, put the number as high as 7000 from about mid-September (the first execution near the village of Kokoszkowy) until January 1940, when the last group of people with mental disabilities was exterminated in the forest.

In most cases, the victims were shot over previously dug death pits. After the war, several graves were found and examined. The conclusions of the prosecutor investigating the mass crimes in the Szpęgawsk Forest were that dozens of bodies could have been hidden in these graves (Kubicki 2019). These are only speculations, however, due to the Aktion 1005 cover-up from the end of October to the second half of December 1944. Aside from one grave that was overlooked, the bodies from the mass graves were exhumed and then burned in an attempt to destroy all traces of them.

Burial Pit as Evidence of the Crime

Archaeological research was carried out in the Szpęgawsk Forest in 2023 (Figure 3). It was supported by an analysis of archival and remote sensing data and geophysical prospection; metal detector surveys were also carried out (Kobińska 2024). The goal was to locate mass graves that had been undiscovered by the Germans themselves in 1944 as well as by the Polish investigative commissions in the post-war period, and to document the process of covering up the evidence in 1944. Although both aspects are widely known in the literature on the subject, they have not yet been adequately documented scientifically. Eyewitness accounts and investigators' findings are ambiguous; written sources, eyewitness accounts, etc., have limitations, and relying solely on them when investigating German crimes in Gdańsk Pomerania narrows the pool of evidence on which one can rely (see also Sturdy Colls 2015).

Necrosol, understood as the filling of a burial cavity, has many features and aspects that distinguish it from its surroundings. The burial pit in the Szpęgawsk Forest examined in 2023 demonstrates this. As a result of the excavation of the original burial pit in 1939 and the exhumation in 1944, the soil differed in colour, structure and physico-chemical properties from the natural layer of the local landscape. The pit was subjected to

archaeobotanical, geomorphological and geochemical analyses (Kobińska *et al.* 2024), alongside research on the recovered material culture and human remains.

The burial pit was 10.5 m long, less than 4.5 m wide and slightly over 2 m deep. The necrosol itself differed within the pit: the contours of the 1944 exhumation were lighter than the immediate surroundings, with visible colours caused by rainwater washing the soil. The first traces of high temperature were already found at this level: charred wood, burnt human remains of various colours and sizes (significant for the analytical process), small artefacts and fragments with a so-called fire patina and layers of dark (black) sand.



FIGURE 3. Work in grave no. 18. A: upper layer of the burial pit, marked by a uniform structure and colour of the soil; B: necrosol consisting of a layer of burned material was already several centimetres below the ground surface (image by D. Frymark).

Importantly, this layer was not homogeneous: small layers of necrosol comprising the above-mentioned elements were separated by layers of dark brown sand several centimetres thick. In our opinion, based on field observations, the remains of burnt human remains together with the remains of the pyres/bonfires were thrown onto the cover of the former burial pit from 1939. This was not a uniform process, as layers of ash and sand indicate that it was carried out alternately, probably with shovels. The layer of burnt material thrown into the earlier burial pit was covered with a layer of natural sand; this process was repeated several times, creating a clear layer of necrosol up to 50 cm thick at the central point (Figure 4).



FIGURE 4. Archaeological work. A: all the soil from the filling of the burial pit was sifted; B: works at the bottom of the original burial pit – in the background, the profile of the burial pit with distinct layers of necrosol is visible (image by D. Frymark).

All the soil from the burial was sifted by the research team. We were able to recover over 400 artefacts or fragments, which were considered evidence for the purpose of the investigation, as well as over 100 samples of charcoal and the necrosol itself from different levels of the burial pit and almost 1400 kg of human remains, comprising mainly burnt bones of small size and various colour.

The burial level from which the Germans removed the decomposing bodies of the victims in 1944 was found below the level of burnt remains. This soil was homogeneous and dark brown. It was also filled with varying concentrations of slaked lime, which was used by the Germans to accelerate decomposition. The thoroughness of the work carried out, which – according to post-war witnesses – took the Special Commando about two months, is evidenced by the small number of artefacts and human remains found at this layer. The soil analysis clearly shows that the burning of the bodies in 1944 did not take place in the original burial pit, but probably in the immediate vicinity. However, although test trenches were opened in parallel with the excavations near the burial pit, these did not yield any positive results.

The remains of two ditches were recorded in the southern corners of the burial pit. There is no information about this type of construction in the post-war accounts of the people who dug mass graves in the forest or who escaped from the execution site. They might have been foundations for platforms built for Aktion 1005 to facilitate the removal of decomposing human bodies with hooks or boat hooks: one of the artefacts found was a rope pulley, which could be evidence of this practice.

The deepest level of the burial pit was of mixed character and was certainly the level of the original burial pit dug in the autumn of 1939 by Poles employed for the work, who – surprisingly – were not murdered afterward and who testified after the war about digging pits (“ditches”) in the forest near Starogard. Larger fragments of human bones with partially preserved anatomical order were found here (Figure 5). In both cases, these were bones from the forearm and hand. Importantly, the victims’ wedding rings were still attached to the phalanges of the remains. One wedding band belonged to a man, the other to a woman. The items are engraved and, in the case of the woman’s wedding artefact, the date of marriage is visible. At the time of writing, intensive archival work is still underway to identify potential individuals to whom the items may have belonged. This find contradicts the opinion of some historians that the victims were meticulously robbed during their arrest and then before their execution in the death pits (Kubicki 2019). This was certainly the case to some extent, but these activities were not as thorough as previously assumed.

However, the characteristics of the necrosol, as regards the layer of burnt material from the grave’s surface layer, clearly indicate that the remains of the victims’ bodies were searched for valuable objects again in 1944. No other valuable items were found in the burnt layer – just small single gold teeth or badly burnt silver coins, and incomplete silver pocket watches that were certainly not of much value to the SS members who supervised Aktion 1005 in the Szpeęgawsk Forest (Figure 6).



FIGURE 5. Examples of human bones found during archaeological research. A: burnt remains of the victims along with fragments of burnt wood from the layer; B: unburnt human remains found at the bottom of the burial pit (image by D. Frymark).



FIGURE 6. Examples of artefacts found in the burned layer in a mass grave. A: cufflink; B: so-called “horseshoe” (metal instep of the shoe heel) (image by D. Frymark).

Soil as Evidence of the Crime

The results of the specialised analyses provided interesting information on how the crime was carried out, and its traces. For example, research into the function and dating of the material culture recovered from different levels of the necrosol confirmed that the burnt layer could not date from before 1939, because artefacts dating from earlier are almost exclusively Polish. Their specificity also proves that both men and women were among the victims. The short and long casings are nearly all German-made, while others confirm the use of captured materials for criminal purposes.

The necrosol was part of the geomorphological research, which also confirmed increased phosphorus levels at all horizons (Hildebrandt-Radke 2023). During the excavation, two profiles were collected. One profile encompassed the most important stratified layers identified in the field within the burial pit. The sampling density in this profile was 10 cm (Profile 1) (Figure 7). A reference profile (Profile 2) was collected outside the burial pit, with the same sampling density. The results of this reference profile serve as a comparison for the samples taken from the burial pit. The organic matter content in the collected samples was determined using the loss on ignition (LOI) method, and the analysis was conducted using a muffle furnace. The percentage of organic matter was obtained by calculating the weight difference of the dry sample compared to the ignited sample, heated at 550°C for six hours (Heiri *et al.* 2001). The calcium carbonate content was determined using the Scheibler method (Myślińska 2001). Soil pH was measured using a pH meter, determining pH in an aqueous medium. Total phosphorus content was determined using the colorimetric method with ammonium molybdate after sample mineralization in 40% HF and 60% HClO₄ (Murphy and Riley 1962).

The crime scene in the Szpęgawsk Forest is an exposed glacial landform formed by the accumulation of sandy, silty and gravelly material in the glacier's crevasses during deglaciation. It is surrounded by wetlands situated about 10 m lower down. The natural soil type in the area is rusty soil, characterised by a specific morphological structure, (O)-A-Bv-C. These soils have high iron and aluminium content in the humus horizon, with values similar to those obtained in the Bv (sideric) enrichment horizon, which is a diagnostic indicator of these soils. The soils have an acidic reaction and leaching of calcium carbonate, with a low phosphorus content reaching up to 400 mg/kg.

The soil profiles inside the mass graves differ from those outside the burial pits (Figure 7). The anthropogenic processes that transformed the soil cover of the Szpęgawsk Forest resulted in the cessation or modification of the rusting process. The graves were covered with memorials, and the burial pits and their contents were excavated and filled several times. An important factor in modifying the soil profiles was the deposition of burnt remains of the victims in the burial pit surface layer. Over time, the charred organic matter migrated down the profile, giving it a darker colour. Despite the naturally unfavourable soil conditions, organic residues, bone fragments and fragments of slaked lime have been preserved.

Research indicates that the dry depositional conditions resulting from the sandy substrate and the shape of the dominant landform, which conditioned rapid surface and subsurface runoff, as well as the covering of the graves with tombstones, had the most significant impact on the good preservation of the fills of the mass graves. The second

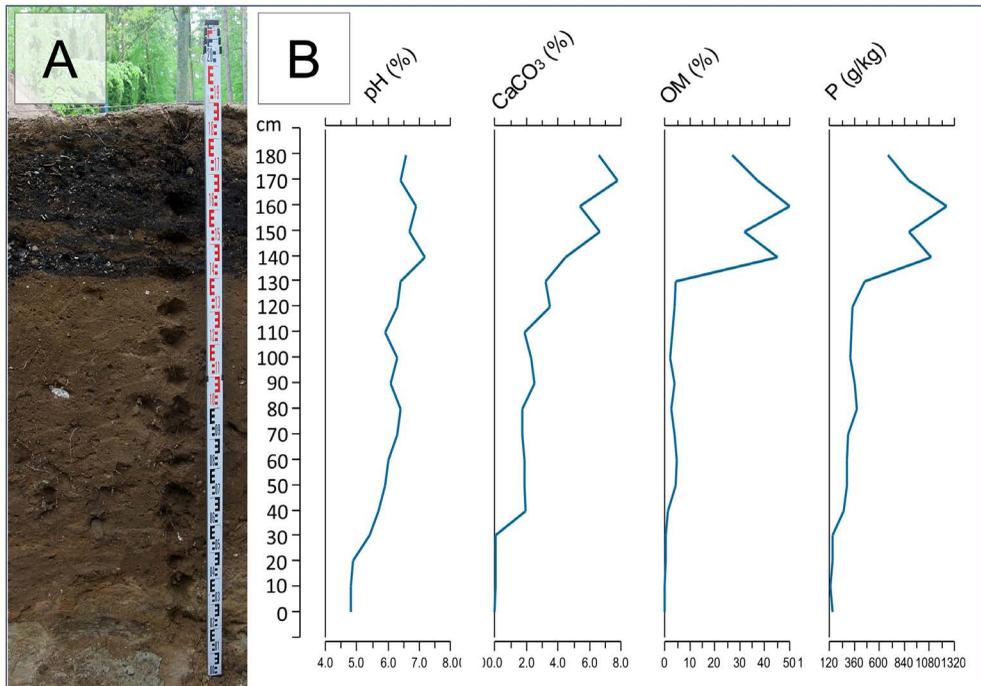


FIGURE 7. Necrosol. A: the profile of the mass grave in the Szpęgawsk Forest (image by M. Czarnik); B: its main geochemical parameters (image by I. Hildebrandt-Radke).

factor, paradoxically, was the process of eradicating the traces of the crime – burning the remains and depositing them with the remnants of the pyre in the burial pit. As a result, the soil properties changed, the reaction became neutral, the organic matter content increased to 30%–40% and the phosphorus content exceeded 1300 mg/kg.

Wood and Charcoal as Evidence of the Crime

Burnt fragments of wood and charcoal were also considered part of the soil archive of evidence of mass crimes in the surrounding forest. The remnants of a pyre were preserved in the grave under study in the form of ash, consisting of charcoal and fragmented human bones. Preparation for the burning of several thousand dead bodies in the Szpęgawsk Forest required an appropriate strategy, planning and efficient organisation, as it was essential to gather a substantial supply of high-quality raw materials. To learn the details of the Aktion 1005 operation, the entire content of the soil filling the burial pit was sifted thoroughly in search of material evidence relating to, among other things, the context of the burning, and the fill of the pit was sieved using screens. Subsequently, the recovered burnt wood, as material evidence of the burning pyre structure, was carefully separated from the excavated human bones and artefacts. Additionally, a set of soil samples was taken for botanical analysis in laboratory conditions, using sieves with smaller mesh sizes than those used during the excavation – specifically, 1.0, 0.5 and 0.2 mm. The samples were collected from the profile of Pit D-0 at 10 cm intervals, from the bottom to the top of

the feature, at depths ranging from 0 to 180 cm. The analytical work showed that burnt wood was the only plant material in the pit's fill. Numerous fragments of charcoal found in the feature were then subjected to microscopic analysis. Identification of the remains using keys, atlases and reference collections revealed that the samples contained a variety of both deciduous and coniferous species. It was determined that pine was predominantly used for the construction of the burning pyre in the Szpęgawsk Forest, followed by hornbeam and beech, with spruce and birch used to a lesser extent (Figure 8) (Rennwanz 2023).



FIGURE 8. Charcoal is part of necrosol. A–B: samples of charcoal taken during archaeological research in 2023 in the Szpęgawsk Forest (image by D. Frymark).

A comparison of the obtained results with the species composition and the age of the local forests confirmed that wood from the nearest area was used to burn the bodies. Important factors in choosing locally sourced raw materials included economic reasons, time pressure and the need to keep the cover-up operation secret. Above all, however, wood from local forests had the desired calorific value. All species of wood used in the construction of the pyre (the bodies of the victims were placed in layers of wood) have very good heating properties. The primary type of wood used for burning was Scots pine, known for its flammability and prevalence in local forests. Additionally, beech and hornbeam were selected as key species due to their density and hardness, which provide excellent heating potential. Their use ensured long and efficient burning. Birch wood was used to ignite and maintain the flame in the hearth, while spruce served as a coniferous alternative to pine or its natural complement. Undoubtedly, the choice of raw materials for the burning – considering both energy efficiency and local availability – played a significant role in the successful implementation of Aktion 1005's objectives.

Animal (Human) Fat as Evidence of the Crime

Finally, geo- and biochemical analyses proved beyond doubt that there were traces of animal fats in the wood and charcoal of the burnt layer (Fabińska 2023). The samples of necrosol as well as fragments of charcoal and slag formed from local soil and the burnt bones of victims were investigated for the composition of organic fraction. The powdered samples were solvent-extracted and the whole extracts analysed with gas chromatography-mass spectrometry. The detailed analytical procedure has been discussed elsewhere (Kobińska *et al.* 2024). The main indicators are fatty acids and their derivatives formed under conditions of high temperature and oxygen deficiency in the combustion zone, i.e. pyrolysis. The range and distribution of fatty acids present in the solvent extracts correspond to those found in animal fat; that is, palmitic (C₁₆) and stearic (C₁₈) acids predominate, and unsaturated acids are almost absent. Soil-derived fatty acids were absent from the samples, as the mass graves were located in sandy, humus-poor soils. The burning of the bodies resulted in the formation of *n*-alkanes, and, in particular, long-chain alkyl amides and alkyl nitriles from fatty acids. The latter's formation mechanism (Simoneit *et al.* 2003) involves the initial generation of alkyl amides which are then converted into the corresponding nitriles (Figure 9a). The distribution of these compounds in the investigated samples corresponds to that of the source fatty acids (Figure 9b). In archaeological contexts, these compounds have been applied to indicate sites of ancient meat frying and/or grilling, for example, by Wang *et al.* (2017) (samples 4000–5050 years old) and Collins *et al.* (2017) (~60,000 years old), which proved the significant resistance to degradation of long-chain amides and nitriles. Jambrina-Enríquez *et al.* (2019) point out the potential of these compounds as markers of the maximum pyrolysis temperature, as they are formed in the range of 250°C–350°C and disappear at temperatures above 450°C.

High concentrations of alkyl amides and nitriles, as high as 31% (w/w) in some of the extracts, show that they are derived from the fats of burnt bodies. In the context of the Pomeranian Crime of 1939 they can be treated as a diagnostic indicator of mass graves (necrosols) subjected to burning as a means of covering up the crime. The thermal conditions during combustion were variable, with temperatures oscillating between 320°C and

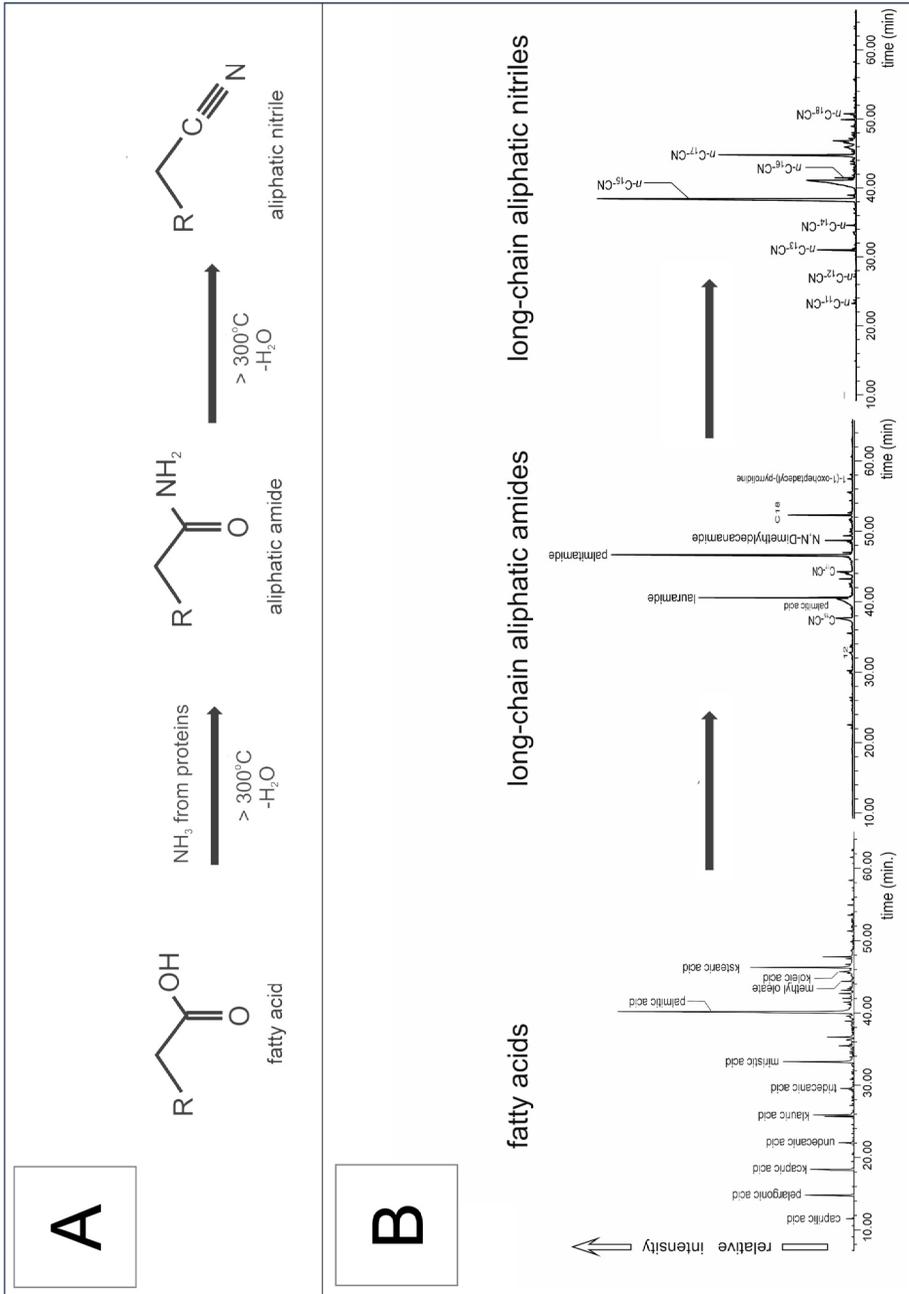


FIGURE 9. Geochemistry of samples from Szpeługawsk Forest. **A:** scheme of aliphatic amides and nitriles formation from fatty acids in oxygen-deficient combustion zone; **B:** distribution of source fatty acids and their products, long-chain aliphatic amides and nitriles ($m/z = 73, 72$ and 97 , respectively) (image by M. Fabiańska).

360°C for some samples or in a slightly higher range of 390°C–430°C, as evidenced by the distribution of *n*-alkanes and polycyclic aromatic hydrocarbons.

The fat here, of course, is nothing less than a material record of the burning of human corpses, whose compounds, as a result of melting and burning, were absorbed into the structure of wood, which was the fuel and building material of pyres. This human fat is the very part of the necrosol.

Conclusion

Nazi German war crimes, crimes against humanity and genocides have been investigated and described by successive generations of researchers and explicated in the various trials of those responsible (Ceran *et al.* 2018). This has also been the case in relation to the mass crimes committed in 1939 in Gdańsk Pomerania.

Already in the autumn of 1939, the archive relating to the organisation of the killings was destroyed in a fake car accident. The bodies of several thousand people were hidden in mass graves in inaccessible places. Moreover, much of the remains were destroyed in the second half of 1944 as part of Aktion 1005. These events posed a fundamental obstacle to prosecution and subsequent historical and archaeological investigations aimed at uncovering the truth about Nazi crimes committed in Pomerania. For many years those sites – in accordance with the intentions of the perpetrators – were successfully hidden and remained unidentified.

Interestingly, the materiality of these crimes has not so far been the main subject of systematic archaeological research. The post-war exhumations were not such an endeavour, as they were subordinated to the ideological goals of authorities during the rule of the Polish People's Party. The exhumations were political, rather than scientific, and aimed at turning society's attention away from crimes perpetrated by the Soviets. "Archaeology of the Pomeranian Crime of 1939" is the first multidisciplinary attempt to address the materiality of the crime and its memory in the present day. Archaeology and the emphasis on the materiality of the crime are intended to provide a new framework for understanding the genocide that occurred in the autumn of 1939 in Gdańsk Pomerania. In the abovementioned circumstances, and from an archaeological perspective, the soil from Pomeranian mass graves is one of the most crucial evidences of a crime. Therefore it must be recognised as the subject of specialised analysis and broader theoretical reflection. The research conducted in 2023 in the Szpęgawsk Forest and its visual documentation is an example of a new approach to the well-recognised but somehow neglected issue of these German crimes from World War II (Figure 10).

Victim lists, arrest reports and interrogation documents can be completely destroyed, which is what we have seen in the case here. The bodies of victims can be exhumed and burnt – which is what the Germans did in late autumn of 1944 in the Szpęgawsk Forest, among other places. But burnt human remains, and even fragments of wood from the burning pyre, compounds produced during the burning and destroyed personal belongings of the victims – indeed, even grains of sand – are evidence of the crime committed. Archaeology and its interest in materiality expands the understanding of what can and does constitute evidence in a case. All these elements make up the necrosol,

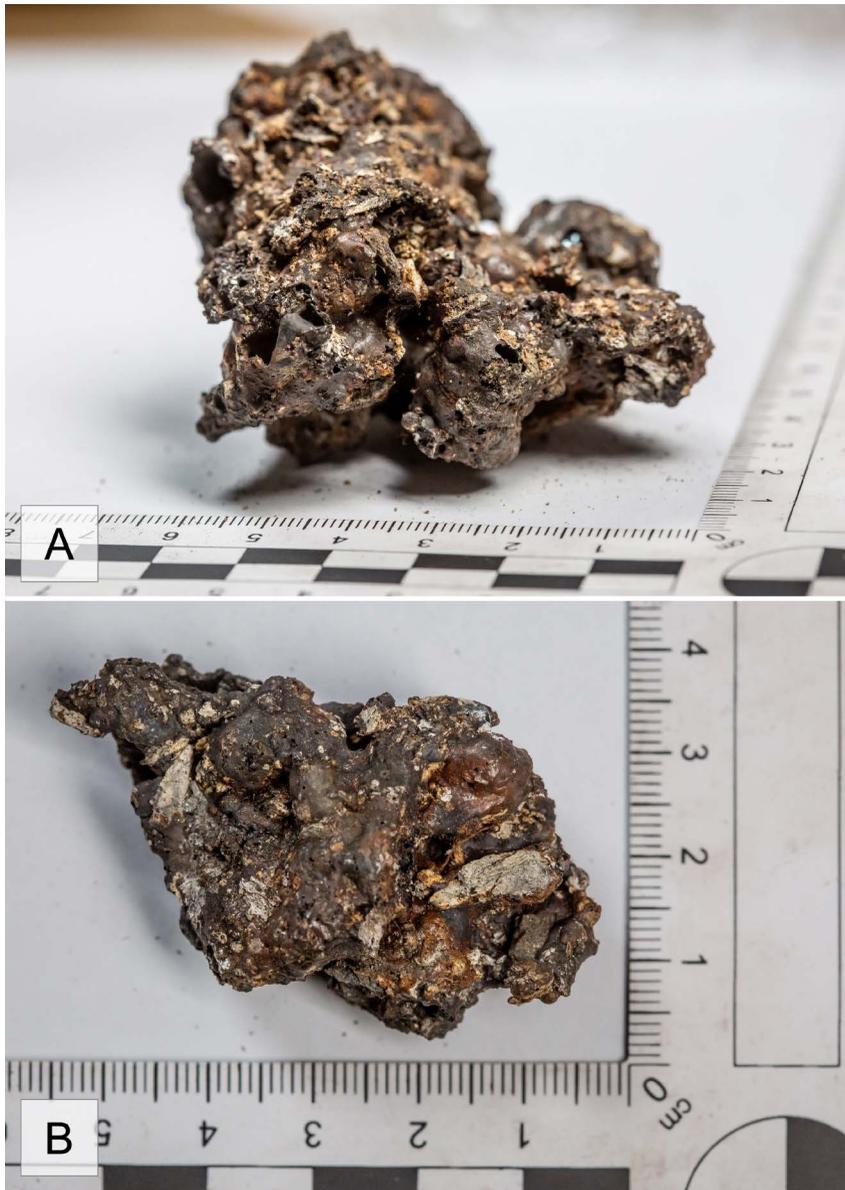


FIGURE 10. Destroying evidence of crimes creates its new prefiguration. A–B: slugs with embedded burned human remains from the necrosol from Szpęgawsk Forest (image by D. Frymark).

the material archive of the genocide that occurred in the Szpęgawsk Forest and some 400 other sites in Gdańsk Pomerania in the autumn of 1939.

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