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HALF A MILLENNIUM OF CONTINUITY: THE RESILIENT BOUNDARY IN THE CZECH CULTURAL LANDSCAPE AND ITS IMPACT ON SOCIO-ECONOMIC DEVELOPMENT

KAMILA HANÁKOVÁ – PETR ŽAŽA – JANA MAZÁČKOVÁ

Abstract: *This study documents legal and administrative manifestations of socio-economic land division during the late medieval period and traces their long-term continuity into the modern era in the Czech landscape. The boundary between the former estates of Jihlava and Třešť (Bohemian-Moravian Highlands) stretches over ten kilometres and is marked by trenches, stones, markers, and natural features. Preserved elements were identified and analyzed with the use of non-destructive methods (LiDAR, DTM, 3D photogrammetry, GNSS) combined with cartographic and archive sources. Data analysis was carried out in ArcGIS Pro. The research confirms that this boundary, with stones dating to 1557, ranks among the oldest documented demarcation lines in the Czech lands. It represents an exceptional example of institutional and territorial continuity. Unlike most estate boundaries, which were typically recorded from later periods, this nearly five centuries old system survived the abolition of feudal administration in 1848 and still shapes current cadastral structures.*

Keywords: *historical boundaries – boundary continuity – territorial transformation – non-destructive methods – early modern age.*

Půl tisíciletí kontinuity: odolná hranice v české kulturní krajině a její dopad na socioekonomický rozvoj

Abstrakt: *Studie dokumentuje právní a správní projevy socioekonomického dělení půdy v období pozdního středověku a sleduje jejich dlouhodobou kontinuitu v české krajině až do novověku. Hranice mezi bývalými panstvími Jihlava a Třešť (Českomoravská vrchovina) se táhne v délce přes deset kilometrů a byla vymezena pomocí příkopů, kamenů, značek a přírodních prvků. Dochované prvky byly identifikovány pomocí nedestruktivních metod (LiDAR, DTM, 3D fotogrammetrie, GNSS) ve spojení s kartografickými a archivními prameny. Analýza dat byla provedena v prostředí ArcGIS Pro. Výzkum potvrzuje, že tato hranice, jejíž kameny pocházejí z roku 1557, patří k nejstarším doloženým liniím tohoto typu na území českých zemí. Hranice představuje pozoruhodný případ institucionální a územní kontinuity. Na rozdíl od většiny hranic panství, které jsou obvykle zaznamenány až v pozdějších obdobích, tento téměř pět set let starý systém přežil zrušení poddanského zřízení v roce 1848 a dodnes ovlivňuje strukturu katastrálních území.*

Klíčová slova: *historické hranice – kontinuita hranice – územní transformace – nedestruktivní metody – raný novověk.*

1 Introduction

This article explores an early modern age boundary between two estates, with particular attention to its continuity, function, and socio-economic role. Notably, the boundary traverses the economic hinterlands of villages deserted only a few decades earlier, offering valuable insights into the organisation of the historical landscape (see Chapter 6).

Research into boundaries has seen a significant development in recent decades involving an interdisciplinary dialogue across the social sciences and the humanities (Newman 2006; Agnew 2008; Marsico 2018). Boundaries and their concepts are not being solely understood as administrative lines demarcating ownership or power influences, but increasingly as instruments shaping collective perceptions of space, authority, and identity (Pohl 1998; Wilson–Donnan 2012). This shift in their perspective offers a deeper examination of both the motivation behind boundary delineation (Karp 1972; Bauer 1988; Nicklis 1992; Tyszka 1995; Marková 2008; 2021) and its long-term impacts on the structuring of space and society. Boundaries created in the past often left lasting imprints on the landscape (cf. Hoskins 1955; Gardiner and Rippon 2007, 1) and even now may continue to serve analogous functions within contemporary administrative

units. Despite such enduring manifestations and functions of historical spatial divisions, their full potential for archaeological research in this specific context remains underexplored. Case studies focused on a specific territory have so far been published relatively rarely, a problem not only for the Czech lands but for the wider Central European region as well. While boundary stones enjoy great attention among amateur researchers who typically share their findings on social media, scholarly attention to this topic has remained limited. Yet their identification can significantly contribute to understanding the relationship between past and present landscape formation. This study specifically aims to address this issue.

1.1 Boundaries in medieval and early modern age society

Boundaries formed one of the fundamental elements of spatial organisation and legal relations in society for centuries. In the landscape, they served as clear reference markers, making it possible to determine where one's property ended and that of another began. Their function ranged from delineating individual plots of land, village or town territories, and ecclesiastical and manorial estates, to forest areas, lordships, and entire territorial regions (CDB II, 362–364 No. 351; 372–375 No. 356; Klabouch–Procházka 1956, 162; Luft 2000, 101; Marková 2016, 22; Jiráček–Vo-máčka 2017, 197).

However, boundaries were not merely an administrative delineation of property. They also reflected the way medieval society perceived and structured space. As “silent witnesses” to agreements, disputes, and power shifts, they carried both legal weight and symbolic authority. Their presence in the landscape conveyed who the space belonged to and who was entitled to use it (Pohl 1998).

In written sources, boundaries appear under the Latin terms *mete*, *termini*, and *limites*. This terminology encompassed both the boundary lines themselves and the specific points or markers that fixed their course (Teplý 1997, 12; Janiš–Šenkýřová 2004, 194). Boundaries were an essential prerequisite for the exercise of property rights and the effective administration of land; their delineation was intended to prevent disputes or unauthorized interventions. They emerged either through customary practice or through formal agreements between parties, often in the presence of neighbours and officials whose attendance ensured the legal legitimacy of the demarcation (Marková 2009, 40).

A wide range of means was used to mark boundaries, which can be divided into three main categories:

1) *Natural boundary markers* included landscape features such as rivers, streams, hills, rocks, forests, or individual trees. These were understood as permanent and indisputable points of reference, and their use reflects a deeply rooted sensitivity to the landscape as a stable framework of existence (Marková 2008, 99; 2016, 22–23).

2) *Artificial markers*, created by human activity, comprised stone heaps, furrows, stones, and carved symbols (often crosses) on trees or stone blocks. A significant element of these markers was the so-called *signa occulta*, hidden identifying signs inserted into the center of the marker, often made of materials not commonly found in the area (e.g., pottery, charcoal, lime, slag, coins), serving as proof of authenticity (CDB II, 372–374 No. 356; 409–410 No. 374; Kiersnowski 1960, 281–282; Peltan 1992, 134; Dohnal–Šída 2007, 635–652; Šlězár 2007, 158; Marková 2008, 103; 2016, 22–23; 2017, 39–40; Klápště 2012, 223–226; Novák 2020, 256–257).

3) *Cultural boundary markers* were long-term stable human-made features – roads, bridges, burial grounds, settlements, or other built or landscape structures. Their historical continuity and symbolic significance endowed them with legal authority and a lasting role in the landscape (CDB II, 362–364 No. 351; 388–391 No. 362; CDB IV/1, 59–64 No. 4; Marková 2008, 100–101).

The delineation of boundaries in the earliest sources from the Czech lands is closely linked to the term *újezd*, which referred to extensive, often forested or sparsely inhabited areas of elongated shape, following natural lines such as watercourses or roads (e.g., Přeštice, CDB IV/1, 71–73 No. 67; Joachimová 1964, 96–98). In Latin texts, this concept is usually rendered as *circuitus*, a term that denoted not only the territory itself but also the manner of its demarcation – namely, the act of walking or riding around the boundary, usually on horseback (*circumire*, *ambire*). This act (*circumequitatio*) held technical, legal, and symbolic significance. It was carried out publicly, in the presence of witnesses – neighbours (*vicini*), nobles, or territorial officials (*coram nobilibus*) – and served as a ritual confirmation of possession (CDB I, 251–256 No. 287; 263–265 No. 295; Podwińska 1971, 202–219; Žemlička 1997, 194–195; Janiš–Šenkýřová 2004, 193–194). In addition to territorial officials (such as beneficiaries), the process also involved summoners (*půhončí*) and foresters (*lovčí*), who were intimately familiar with the terrain and capable of accurately determining the course of the boundary. Sources often state that the boundaries were marked out specifically by foresters, without any objections from neighboring parties, which testifies to their professional authority (CDB II, 393–396 No. 364; Jan 1999, 193–195).

This method of boundary delineation is documented from the 11th century and persisted until the mid-13th century.¹ It was not an exclusively Czech phenomenon, analogous practices and terminology (*circuitio*, *ambitus*) also appear in Silesia and other regions of Central Europe (Podwińska 1971, 202–219). However, with the development of settlement structures and the centralization of administration, the meaning of the term *circuitus* shifted to denote administrative districts rather than specific territories. Its usage gradually disappeared, with some of the latest evidence found in charters from the 1230s, where it still appears in the delimitation of the so-called Semislav *újezd* (CDB III/1, 215–216 No. 174; Teplý 1997, 29). The *újezd* thus represents only one of the ways boundaries were delimited in the Early Middle Ages. More generally, boundaries were perceived as indeterminate zones of the landscape, often following watersheds, border forests, or other natural features. However, more precisely defined linear boundaries existed concurrently in some regions already from the 8th century, showing that strip-like and linear boundaries coexisted from the beginnings of spatial delimitation (Irsigler 1991, 11).

From the 13th century onwards, there was a shift toward linear and legally codified boundary delineation, known as *recta linea*. This type of linear boundary can be first discussed in connection with the year 1179, following the death of Vladislav II, during a Czech–Austrian dispute over the Vitorazsko region (CDB I, 258–259 No. 291; Marková 2009, 41; 2016, 23). Whereas in earlier periods boundaries were often understood as broader zones in the landscape (e.g., “the middle of the forest” or “wilderness”), a specific line, whose course was detailed in charters, began to be established. Written records started to consistently describe individual parcels, arable and uncultivated land, meadows, pastures, forests, flowing and still waters. The turn of the 13th and 14th centuries brought the first explicit mentions of artificial boundary markings, through carvings, stones, or symbols carved into trees. This new approach reflected an increasing emphasis on legal certainty, permanence, and verifiability, especially in environments where natural landmarks were lacking or could be easily disputed (Teplý 1997, 9–32; Velímský 1998; Marková 2008, 105).

The 16th century marked a turning point in the institutionalisation of boundary delineation and the growing importance of provincial surveyors (Sedláček 1923, 290; Kreuz–Martinovský 2007, 162). What had originally been auxiliary officials developed into a professional institution with its own office, oath, and fees for specific tasks. Their surveying of land played an important role in court disputes (Honl 1958, 148–151; Starý 2020, 175). Provincial surveyors were not only responsible for measurement and demarcation but also acted as cartographers,

¹ The recording of boundary delineation in written sources from the 11th century demonstrates both the significance and the sophistication of spatial organisation. A similar principle likely applied to the demarcation of village boundaries, as suggested by current research in Mstěnice. This research indicates that such boundaries were not merely legal constructs – they remained alive in the collective memory of local inhabitants, who knew, remembered, and navigated them even after the introduction of emphyteutic law, which formalised these traditional boundaries within a new legal framework.

visually documenting territorial claims. Evidence of this includes a surviving map of the Nová řeka area, kept in the State Regional Archive in Třeboň, and Podolský's 1599 map depicting the disputed boundary between the Mirošov and Osek estates near the village of Trokavec. These maps represent the oldest surviving cartographic documentation by provincial surveyors (Roubík 1953, 97–99; Starý 2020, 177).

As surveying practices became more formalised, legal codification followed suit. While medieval charters describe individual cases and processes of boundary delineation, the systematisation of this practice came only in the early modern period. In the Czech context, important legal codifications were adopted, such as the Tovačov Book of Municipal Law from the late 15th century (KTov), the Drnov Book from the first half of the 16th century (KDrn), and especially the Legal Book of Jakub Menšík of Menštejn from 1600 (Jireček 1883; Janiš–Šenkýřová 2004, 193). In Bohemia, codification reached its peak with the treatise by Jakub Menšík of Menštejn in 1600, which became the comprehensive manual for resolving boundary disputes. Menšík's work not only consolidated existing practices but also introduced standardised terminology, including precise definitions of *mezník* ("boundary stone") and *hraničník* ("boundary marker"; Jireček 1883, 192–197). These normative texts stabilised earlier medieval practices and confirmed that boundary delineation had become a routine part of legal and administrative life.

In Bohemia, a separate boundary court was established, specialised in disputes over borders between two feudal estates; its activities often took the form of an itinerant tribunal that inspected the contested sections. Within the individual estates, however, disputes remained under the authority of the local lord, demonstrating that the legal framework was differentiated and respected the hierarchy of property rights (Starý 2020, 170). The first provisions regarding the composition of the boundary court appear in the Bohemian land ordinance of 1549, highlighting the gradual institutionalisation of these practices (Stieber 1914).

In Moravia, boundary disputes fell under the jurisdiction of the provincial court (Janiš–Šenkýřová 2004, 196), which also required direct, on-site verification of the border, often carried out by lower-ranking officials. Each party had to bring witnesses to confirm the boundary's course "from time immemorial." In cases of dispute, the court would proceed to a solemn swearing of the witnesses, as detailed in the Drnovská Book (KDrn, 60).² This ritual, evoking themes of death and the Last Judgment, underscored the gravity and indisputability of the testimony. The ritual also involved younger generations – boys from surrounding villages were ritually punished so that they would memorise the boundary and in the future become "boundary witnesses." The Moravian land ordinance of 1535, building on the parliamentary resolution of 1520, stipulated that minor officials had to present their witness reports before the provincial court directly in the presence of both parties, who could not interfere arbitrarily (ZZ 1535, 71 No. 60;³ Janiš–Šenkýřová 2004, 197). Records from the *Knihy pŕuhonné a nálezové* (records of summonses and judgments) of the Moravian provincial court show that the boundaries were defined by specific physical features, such as stones and hills (LCS V/1, 151–152 No. 630),⁴ fences (LCS V/1,

2 „Co se týče přísahy od svědků na mezích, že se totiž vyryl hrob, na vymýřené pak zemi se prostřel koberec a naň krucifix, že svědčí bosí, v košilích čili odpásání a zbraň odloživše a v svlekov, v hrobě klečce přísahali.“ (“As for the oath taken by the boundary witnesses, it was described that a grave was dug, a carpet laid on the cleared ground, with a crucifix placed upon it, and the witnesses, barefoot and in their shirts – that is, girded with their belts removed, and having laid aside their weapons – knelt in the grave and took the oath.”)

3 „Kdež by úředníci práva menšího na meze vedli anebo hranice a tam se jim ukazuje potřeba obojí strany a páni potom jejich zprávu tejně jsů vyslyšchali a nález na to učiniti ráčili. Na tom zuostáno, aby již toho více nebyvalo, než kdyžkoli úředníci práva menšího na meze a hranice požádání budů, cožkoli od obojí strany vyslyší aneb před nimi okázáno bude, o tom, aby zjevnů zprávu před pány soudci činili v přítomnosti obojí strany (...).“ (“Whenever the lower-ranking officials of the law led the boundaries or borders, and both parties were required to appear, the lords would then hear their report and would issue a finding accordingly. It was decreed that no further action should be taken beyond this: whenever the lower-ranking officials of the law were requested to inspect the boundaries, they were to provide a clear report before the lords and judges in the presence of both parties, based on whatever they heard or observed in front of them.”)

4 „(...) úředníci odtud, kdež ještě křoví od lužku najdal v pastvisko se vtáhlo, rozdělíc rovně a upřímě meze udělati mají, buď kopci neb kamením k věčnosti, a to seno z toho pastviska sklizené mají sedláci pobrati do Boršova.“ (“[...] the officials, from the place where the bushes still extended from the meadow into the pasture, were to divide and establish the boundaries straight and properly, whether by hills or by stones, for all time, and the hay harvested from that pasture was to be collected by the peasants for Boršov.”)

121 No. 502),⁵ ditches, trees (LCS IV/1, 238 No. 1062),⁶ or by rivers – and their existence was confirmed through a combination of legal regulation and the witness memory of local inhabitants.

The participating lords left protocols concerning the surveying and revision of boundaries. In the archives of large estates, descriptions of estate boundaries have been preserved – either of the entire territory or of specific sections. These records mostly date from the 18th and 19th centuries, although in some cases they originate from the second half of the 17th century. During the 18th and 19th centuries, the greatest number of boundary stones was preserved, as this period saw systematic mapping and stabilisation of estate boundaries (Jiráček–Vomáčka 2017, 197).

1.2 Study area and historical background

Such an underexplored boundary lies between the former estates of Jihlava and Třešť in the Bohemian-Moravian Highlands and became the focus of our research (Fig. 1). A part of the Lovětinický újezd, mentioned in 1227, was located within this area (Richter 1953, 9). The region was shaped by late colonisation in the 13th century. Settlement development along watershed lines further contributed to ideal conditions for the emergence of stable administrative boundaries (Dobiáš 1931, 56–59; Měřinský 1983, 192–193; Navrátil 1986, 53–55; Vohryzek 2015, 37–40; Mazáčková 2017, 753–757). Such division lines were influenced by socio-economic transformations driven by two key factors: agriculture and silver mining.

While Jihlava became one of the most important mining centres in the second half of the 13th century all across the Czech lands (Vosáhlo 1999, 52–56; 2001, 106–108; Hrubý et al., 2007, 17–20; 2011, 3; Derner et al., 2019, 931–933), mining near Třešť developed a bit later and on a smaller scale (Vosáhlo, 1988). However, as the profitability of local deposits declined, mining gradually lost its importance, and by the 16th century, its role within the market economy had diminished (Hoffmann 1967, 163; 1999, 92–95). On the other hand, agriculture remained a stable primary component of the economy and came to the forefront of the strategic interests of the nobles. Subsequently, both estates began to pursue the acquisition of surrounding villages, including higher-elevation settlements such as Lovětín, Pfaffendorf, and Otín. Although these villages were deserted in the second half of the 15th and first half of the 16th century, (Hosák 1938, 11–12, 15; Nekuda 1961, 125, 133; ZDB XVIII, 140 No. 82; XXVI, 265 No. 2) they played a key role in defining administrative spheres of influence. Later on, their extensive agrarian hinterland became part of the administration of larger neighbouring estates: Lovětín became part of Třešť, Pfaffendorf, and Otín belonged to Jihlava (Fig. 1; MZA, 1835, 1835a).

This development was closely tied to the political and property dynamics of the mid-16th century. Until at least 1556, the Třešť estate was headed by Matěj Vencelík of Vrchoviště (1513–1556?), who had already incorporated nearby villages into the estate in 1517, thereby strengthening his territorial influence in the region (ZDB XIX, 158 No. 32). In 1531, Matěj granted his daughter Barbora the villages of Rozsíčka, Stajišť, and Bezděkov to hold and use (ZDB XXIV, 213–214 No. 43). At the beginning of 1556, he was succeeded – likely by his son – Kryštof Vencelík of Vrchoviště. The Vencelík family, settled in Třešť since 1493, represented a prominent entrepreneurial lineage with roots in silver mining in Kutná Hora. Following the mid-16th century, mining activity resumed in Hvězdovice (today's Jezdovice), but the mines on the Třešť estate were operated primarily by small-scale private entrepreneurs and yielded only modest returns (Štrejn 1966, 7). This suggests that agriculture had overtaken mining as the dominant economic

5 „Leta etc. LXXXV v neděli po sv. Lampertě mor., vyznání učinil před pány na sněmu obecném, že času některého, prve, než jsú se války krále Jiřího strhly, Přerovský kopec osazovati a oplétati počal (...)“ (“In the year 1485, on the Sunday after St. Lampert of Moravia, he made a declaration before the lords at the general assembly, stating that at some earlier time, before the wars of King George broke out, he had begun to fortify and fence the Přerov hill [...].”)

6 „Mikuláš z Drahanovic a z Koběřic poh. paní Magdalenu z Bošovic etc. ut sup. z šedesáti hř. gr. dob. stř. etc., že mi drží flek lesu a duby hraničné srubali, ježto mi jest ukázáno od starých lidí.“ (“Mikuláš of Drahanovice and of Koběřice Lady Magdalena of Bošovice, etc., testified under oath from sixty guilders of good silver, etc., that he holds a plot of forest for me and that the boundary oaks were cut down, as it was shown to me by the elders.”)

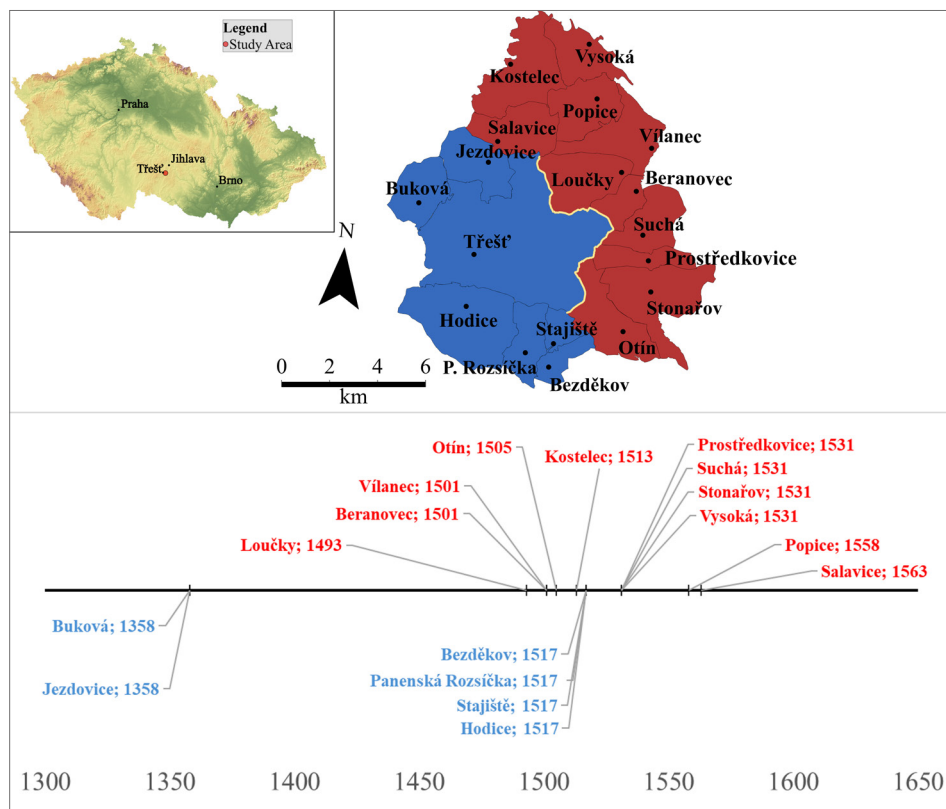


Fig. 1. Research area and demarcation of the estate boundary between Jihlava and Třešť. Territory of the Třešť estate (blue) and part of the Jihlava estate (red), showing the demarcated boundary (yellow line) and a timeline of village incorporations under their administration (Hosák 1938, 6, 10–13, 15–16). Image by the authors, based on data from ČÚZK.

Obr. 1. Zkoumané území a vymezení hranice mezi panstvími Jihlava a Třešť. Území třešťského panství (modře) a část jihlavského panství (červeně) s vyznačenou hranicí a časovou osou začleňování jednotlivých vesnic do jejich správy (Hosák 1938, 6, 10–13, 15–16). Vytvořeno autory na základě dat z ČÚZK.

driver in the region, making it increasingly important for the new estate owner to clearly delineate his landholdings, particularly in relation to neighboring Jihlava. The need for precise boundary definition was likely even greater on the side of the Jihlava estate, given its status as a royal town with expanding territorial claims and administrative authority.

Meanwhile, the Jihlava estate focused on acquiring villages with a history of silver mining, purchased from burghers of Jihlava whose families had long been associated with mining administration. While silver mining gradually declined, these acquisitions were motivated both by the agricultural hinterland and the remaining potential for mineral resources (Hosák 1938, 6). At the same time, cloth production emerged as an important new economic activity in Jihlava (Werner 1861; Janáček 1958, 70–75; Hoffmann 1999, 87–90).

Shortly after, Jihlava faced significant political and economic challenges. In 1547, it was the only royal town in Moravia to join the estates' revolt against the king. Although the town was threatened with confiscation, its estates were ultimately spared. However, Jihlava lost its privileges, paid a fine of 25,000 thalers, and committed to a permanent beer tax. Royal favour was restored only in 1549. In 1551, a fire destroyed around one hundred houses, including the town hall, for which Jihlava received a six-year tax relief. Epidemics of plague in 1562, 1566, 1571, and

at the turn of the 16th and 17th centuries killed thousands of inhabitants (Hosák 1938, 6). The fire and plague had a significant impact on the town's economy and population. Consequently, maintaining or expanding the controlled agricultural hinterland around Jihlava became crucial for securing food supply and stable income.

A decisive moment occurred in 1557 when a fixed boundary line was delineated, definitively separating the property claims of the two estates comprising the hinterlands of the deserted villages and extending beyond their former settlement areas (Fig. 2).

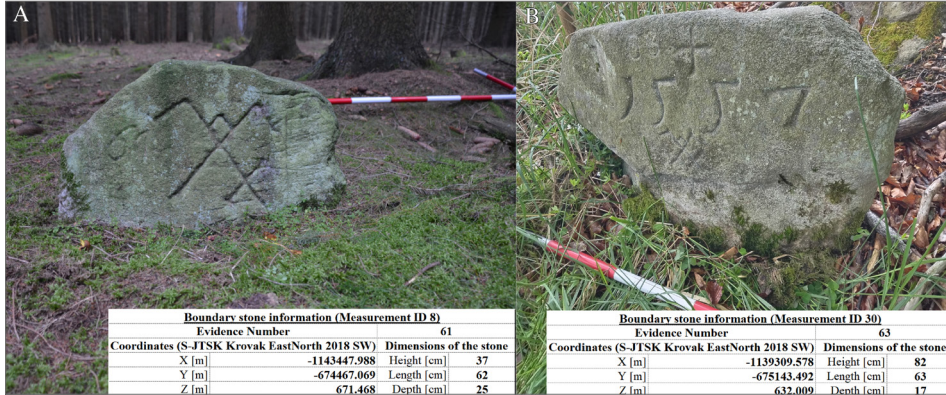


Fig. 2. Boundary stones marking the 1557 estate demarcation. A) Boundary stone No. 8 bearing the mark of Jihlava councillor Šebastian Suleh, who commissioned the demarcation of the studied boundary (Jaroš 1994). B) Boundary stone No. 30 inscribed with the year 1557 and the same mark. Image by the authors.

Obr. 2. Hraniční kameny vymezující panství podle rozhraničení z roku 1557. A) Hraniční kámen č. 8 nesoucí značku jihlavského konšela Šebastiana Suleho, který nechal vymezit zkoumanou hranici (Jaroš 1994). B) Hraniční kámen č. 30 s vyrytým letopočtem 1557 a stejnou značkou. Vytvořeno autory.

The newly defined boundary represented more than an administrative alteration for the local inhabitants. The landscape still bore traces of earlier boundaries, but this new line significantly transformed their everyday lives. It brought new relationships with the estate, changes in taxation, and a reorganization of property administration by newly binding regulations (Janiš–Šenkýřová 2004; Zorn–Mikša 2022, 922). Over time, the boundary became part of the shared perception of space and has taken a firm spot within the local customs, as described by Paasi (1986) in the context of regional identity institutionalisation.

In the following centuries, though this boundary remained strong and was rarely re-surveyed, such events often served to confirm its origin and persistence. A new demarcation was required only in impassable marshy sections (Peltan 1992, 133). The boundary stability was enhanced by the later afforestation of the majority of the former agrarian hinterland belonging to deserted villages (Fig. 3). This afforestation, driven by the nobility's response to currency devaluation (inflation in modern terms) and declining profitability of extensive agriculture, led to the transformation of parts of the landscape into forested areas used for forestry and hunting (Měřínský 1983, 192–193; Mazáčková 2017, 746–748). The forested zone, including the delineated boundary, is visible on the first stable cadastre (Franciscan Cadastre)⁷ from 1835 (MZA, 1835, 1835a).

In the mid-1950s, during the collectivisation process carried out under the communist regime in Czechoslovakia, a large portion of historical boundary markers was removed (Jiráček–Vomáčka

⁷ The Franciscan Cadastre represents the earliest cadastral survey to incorporate detailed physical measurements of land, visualised through maps of individual settlements. These maps, commonly referred to as Indication Sketches, have been utilised in this study.

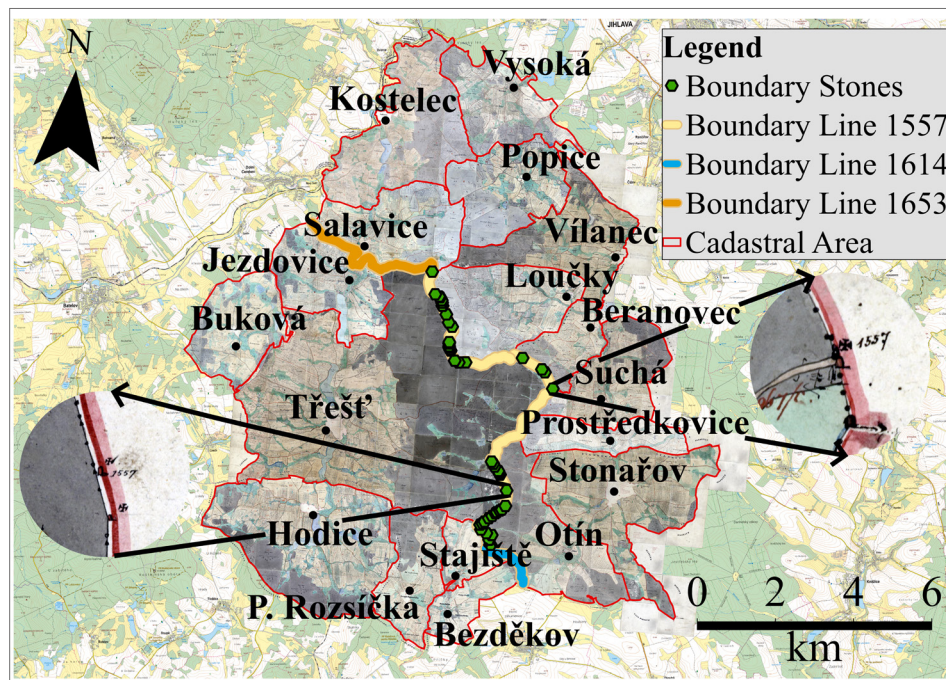


Fig. 3. Boundary course on the 1835 Franciscan Cadastre and the modern cadastre. The full course of the boundary as depicted on the 1835 Franciscan cadastral maps, with recorded positions of boundary stones. Image by the authors, based on data from ČÚZK and archive materials from Moravský zemský archiv, Brno.

Obr. 3. Průběh hranice na františkánském katastru z roku 1835 a na současném katastru. Úplný průběh hranice zobrazený na františkánských katastrálních mapách z roku 1835 se zakreslenými pozicemi hraničních kamenů. Vytvořeno autory na základě dat z ČÚZK a archivních materiálů z Moravského zemského archivu v Brně.

2017, 198). This intervention was part of a broader process of land nationalisation, which led not only to a restructuring of ownership relations but also to a disruption of the landscape structure (Rokoský–Svoboda, 2013). However, thanks to its forested and remote location, the studied boundary line remained preserved and has survived to the present day. In recent years, however, bark beetle infestations and intensive logging have caused significant damage to forest sections (Mazáčková–Žaža 2022, 44–48) of historical boundary features, including the removal or displacement of several stones and disturbance of the line by heavy machinery. Although these disruptions affect only limited segments, they make the systematic documentation of these boundary features more urgent than ever before (Irlinger and Suhr 2017).

2 Research aim

The research aims to answer the following fundamental questions.

Firstly, whether the boundary's functionality and continuity have persisted from its beginning to the present day? Secondly, what role has the boundary played in driving socio-economic change, legal regulation, and territorial restructuring over the centuries?

To answer these questions, we undertook a comprehensive documentation and analysis of an early modern boundary between the former Jihlava and Třešť estates in the Bohemian-Moravian Highlands. This boundary represents a vital, long-term continuous piece of landscape heritage. Utilising a multidisciplinary approach that combines advanced non-destructive techniques (LiDAR, DTM, 3D photogrammetry, GNSS) with extensive cartographic and archive sources, the

study seeks to confirm its historical origins, notably the boundary stones dated to 1557. This work ultimately highlights the unique resilience of historical land divisions and their enduring influence on the contemporary Czech landscape, offering insights valuable to experts from various disciplines within cultural heritage, including historical geography, archaeology, conservation, and land management.

3 Description of the boundary between town estates from archive sources

The following overview of archive references to the boundary between the Jihlava and Třešť estates is based on the compilation by Peltan (1992).

The boundary dispute between the Jihlava estate and the Třešť estate is archivally attested for its younger part running between Jihlava and the villages of Bezděkov and Stajíšť, which belonged to Třešť (Fig. 3). In 1614, the stillunsettled line was examined by a commission composed of representatives of both estates, whose task was to precisely delimit it and give it a legal claim to prevent recurrent conflicts (Listiny /1240/ 1269–1900, 1269; Peltan 1992, 132). This boundary section continued the earlier demarcated line from 1557, the principal subject of the present research, for which further archive records survived.

Although the original course of the boundary barely changed over the centuries, there is evidence of a couple of revisions in 1693, 1787, and 1860. These revisions responded to landscape changes such as the loss of original markers or the need to reconfirm its legal claim. The earliest surviving description, from 1693, records the disposition and names of the boundary stones, their marks, and associated field points such as boundary trees bearing crosses, stumps, watercourses, and old roads (Granitz Beschreibungen, des Mährischen, als auch Böhmisches Seite, 1693). Specific inscriptions, such as the word ‘FRIDE,’ symbolizing the cessation of disputes, and abbreviated dates like ‘57,’ have been recorded (Author 2025, No. 20, 31). By that time, the boundary remained unchanged as it was only surveyed by foot, and its course was recorded (Peltan 1992, 132–133).

In 1787, a new survey began at the boundary stone with three crosses near the village of Salavice. The archived description states that the stone was situated on a layer of brick rubble, glass shards, and metal fragments. The boundary was confirmed by the presence of officials and neighbours from the surrounding villages, thereby acquiring a legal claim. In the marshy sections where the original stones had disappeared, the boundary had to be resurveyed, staked out, and marked with the year 1787. The archive record specifically mentions two stones located in the Loučky forest district: stone No. 40, named *Gesturzten Stein*, and the *Staffelstein*⁸ (Granze Beschreibung zwischen der Hoch- und Reichsgrafflich Herbersteinschen Herrschaft Triesch und der k. Stadt Iglau, Prothocoll, 1787; Peltan 1992, 133–134).

Further adjustments to these marshy parts were undertaken in 1860. Due to the difficult access and unstable ground, drainage trenches were dug in the wetlands. A dispute over the demarcation between the villages of Loučky and Jezdovice prompted a new discussion, during which the old descriptions were compared with the new cadastral map and boundary stones, numbered from 1 to 81, were set. The intervention served both practical and legal: to confirm and stabilise the course of the old boundary in a changing terrain. The archive record provides explicit information on the locations of the stones. For example, stone No. 30 stands by a spring, known as *Grenzbrunnen* (literally “boundary spring,” in Czech *hraniční pramen*), while stone no. 28 is situated on a meadow called *Dammwiese*, which is also shown with its name on the Franciscan cadastres (Grenzbeschreibungen Protocoll, 1860; MZA 1835a; Peltan 1992, 134–135).

Particular emphasis was given to the legal anchoring of the boundary and on ensuring its precise location. Its course had to be memorised by so-called *boundary witnesses*. Young boys from the neighbouring villages came to the event, and the current location was imprinted on their memories by a ritual corporal punishment. As Ctibor Tovačovský notes, “*A pacholata malá i větš*

8 Although the Staffelstein was named after the Jihlava area *Staffei*, its original marker No. 49 could not be located in this research.

při to mítí a mají mrskati, aby hranice a jich vyměření pomněli” (KTov, 127).⁹ Coming through the ritual, young boys had become lifelong boundary witnesses. This tradition guaranteed their ability to bear future witness to the correctness of the demarcation (Jireček 1883, 178; Janiš–Šenkýřová 2004, 201; Šlězár 2007).

4 The boundary formed through deserted villages

In the forested area between Třešť and Stonařov, written records claim the existence of three deserted villages mentioned previously – Lovětín, Pfaffendorf, and Otín. Otín was partially re-established in 1778 through the parcelling of the manor farm, which also led to the renewed use of part of its former agrarian hinterland (Hosák 1938, 11–12, 15; Nekuda 1961, 125, 133; ZDB XVIII, 140 No. 82; XXVI, 265 No. 2). The situation regarding Lovětín was more complex. Below the Petrchovský pond,¹⁰ a field division (*plužina*) with a regular structure of 12 field strips per parcel, which was considered part of its hinterland was identified (Navrátil 1986, 206–208; Horák et al. 2018, 15). Hence, the site became the subject of further investigation, as the different widths of the strips (unlike those typically associated with Lovětín) led to the hypothesis that a separate settlement might have existed there. It was directly on the grounds of these field systems, that a boundary between the estates (nowadays the cadastral areas of Třešť and Beranovce) was delineated in the second half of the 16th century, likely reflecting the contemporary settlement and economic structure (Fig. 4).

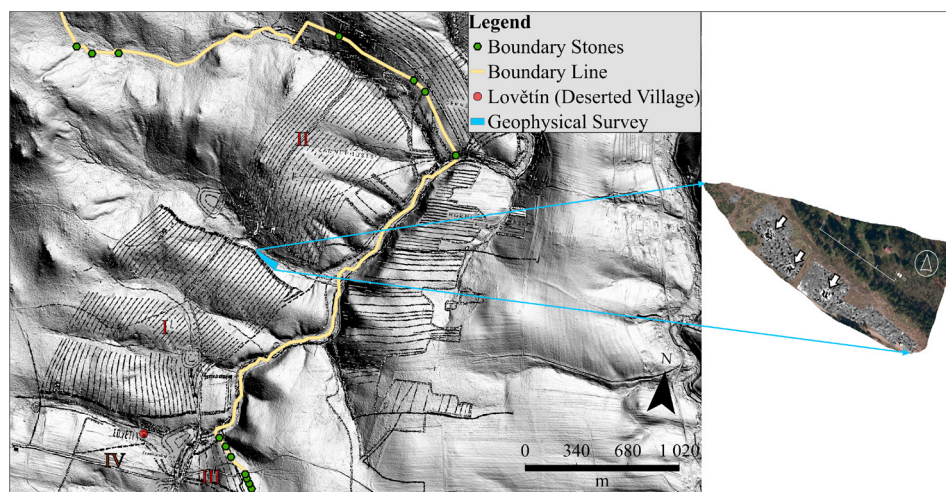


Fig. 4. Reconstruction of the field system and settlement structure of the deserted medieval village of Lovětín. The surrounding fields and their composition (*plužina*) of the deserted medieval village Lovětín, reconstructed after Navrátil (1986, 207). The fields are divided into three main sections: sections I and II consist of plots each containing twelve ridges, regardless of parcel width. Geophysical surveys identified three homesteads (white arrows) associated with section II. Section III is characterized by widened, radial plots. Section IV is a presumed extension of the surrounding fields, suggested by the discovery of two rows of houses on both the northern and southern edges of Lovětín. The results of the geophysical survey were processed and interpreted by Jan Havelka. Image by the authors, based on data from ČÚZK.

Obr. 4. Rekonstrukce plužiny a sídelní struktury zaniklé středověké vesnice Lovětín. Okolní pole a jejich uspořádání (*plužina*) zaniklé středověké vesnice Lovětín, rekonstruované podle Navrátila (1986, 207). Plužina je rozdělena do tří hlavních částí: část I a II tvoří parcely, z nichž každá obsahuje dvanáct záhonů, bez ohledu na šířku jednotlivých parcel. Geofyzikální průzkum identifikoval tři usedlosti (označené bílými šipkami) náležející k části II. Část III se vyznačuje rozšířenými, radiálně uspořádanými díly. Část IV představuje předpokládané rozšíření okolních polí, naznačené objevem dvou řad domů na severním a jižním okraji Lovětína. Výsledky geofyzikálního průzkumu zpracoval a interpretoval Jan Havelka. Vytvořeno autory na základě dat z ČÚZK.

⁹ “Both the younger and older boys were to be present at the inspection and were to be whipped so that they would remember the boundary and its measurement” (KTov, 127).

¹⁰ In the cadastral area of Třešť.

The field system may have continued south of Lovětín. Its precise identification, however, is currently hindered by destructive interventions caused by intensive logging. Below the dam of the Lovětín pond, several features, presumably associated with metallurgical production, have also been identified at the site, which had already been investigated in the 1960s (Brázda 1967, 16)

Each of these villages had its own economic hinterland – an area directly connected to the village, used at the time of its desertion primarily for food production and for securing the livelihood of its inhabitants. This hinterland was delimited in the landscape by land divisions that together formed the Lán unit. The Lán had a dual function: as a unit for measuring area and as a basis for determining taxes and obligations to the nobility (Salaba 1927, 145; Bumba 2007, 14–15; Mazáčková–Žaža 2021, 92–93). The practical significance of this structure is also evident from legal transactions: written deeds and sales of villages clearly document the delineation and land registry. For example, a document from 1496 documenting the sale of the already deserted village of Lovětín includes all of the village's assets – individual homesteads, arable and non-arable land, meadows, pastures, forests, bodies of water, mines – and explicitly mentions boundaries and markers, confirming that the village was a legally defined unit.

“Zygmund z Hodic knězi Václavovi z Hodic ten díl, kterýž se knězi Václavovi po otci jeho v Hodicích, v Rosičce a v Stajišci a Bezděkově a na Lovětína dostal, s rybníky, s rybníšči, s potoky, s mlýnem pod Kamenným rybníkem, s lidmi platnými i neplatnými, s roli oranů i neoranů, s vodami tekúcími i netekúcími, s lesy, s chrašinami, s lukami, s pastvami, s pastvišcemi, s horami, s doly i s plným právem i se vším plným panstvím, tu sobě ani erbóm svým ni- žádného práva, panství ani kterého vlastenství nepozůstavuje ani zachováváje, v těch mezích a hranicích, než to všecko, což on tu má a což k jeho dluhu přísluší, jakož šíře listové dílci svědčí a sami v sobě zavírají, to všecko vkládám a vpisuji ve desky zemské ku pravému dědičnému jmění a požívání” (ZDB XVII, 84 No. 33).¹¹ Without such a defined set of plots, these transactions would not have been possible, as this structure provided legal and economic security.

The boundary between the Jihlava and Třešť estates was delineated shortly after the villages were deserted, in 1557, on territory that still bore traces of the previous division of the economic hinterland into parcels. The visible furrows of the plužina and the spatial arrangement of the fields provided a legible framework of the landscape, which shaped not only the practical use of the land but also the organisation of property and legal relations over time.

5 Material and methods

A complex analysis of the historical boundary and its related landscape was based on a combination of methods focused on spatial, material, and contextual topics of research.

LiDAR allows the creation of a detailed DTM providing high-accuracy imagery and resolution up to decimals of centimetres. The commonly used model database in Czechia is DMR 5G (Digitální model reliéfu 5. generace; Holata and Plzák 2018, 24–26), obtained through flight laser scanning in the years 2009–2013 scoring a height error of 0.18 metres in open fields and 0.3 metres in forested areas. LiDAR data proved crucial for identifying the boundary of the studied area, taking into account that the boundary was depicted as a shallow linear depression. Visual representation enhancement was established using a hillshade feature from the DTM. This model highlights subtle terrain features, such as boundary lines, by simulating shadows according to the terrain's orientation and sunlight direction (Fig. 5). The hillshade thus provides a contrasting shading that eases the detection of even minor changes in the landscape, such as depressions and elevations, making it particularly well-suited for tracing historical features such as former boundaries.

¹¹ “Zygmund of Hodic grants to the priest Václav of Hodic that part which came to the priest Václav after his father in Hodic, in Rosička, Stajišče, Bezděkov, and Lovětín, together with ponds, fishponds, streams, the mill below the Stone Pond, with all men, both free and unfree, with arable and untilled land, with flowing and non-flowing waters, with forests, brushwood, meadows, pastures, grazing grounds, hills, mines, and with full rights and all lordship. He does not leave or retain for himself or for his coat of arms any rights, lordship, or property outside the boundaries and limits of all that belongs to him and to his share, as the leaf-like divisions of the charter testify and enclose within themselves. All of this I insert and enter into the land registers as true hereditary property and for full enjoyment” (ZDB XVII, 84 No. 33).

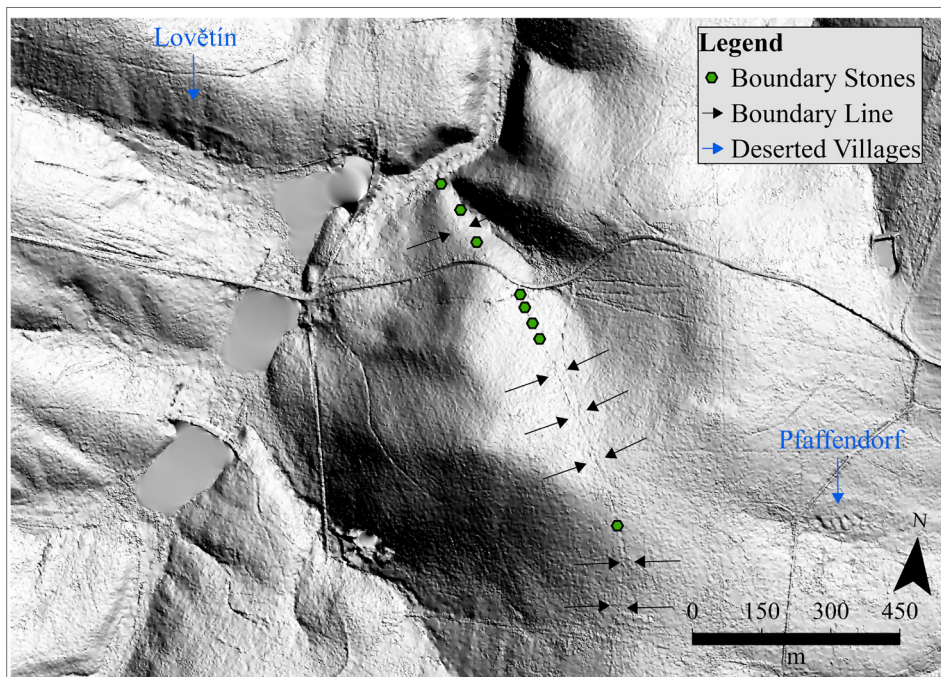


Fig. 5. Boundary ditch analysis by DTM (LiDAR) near Lovětín and Pfaffendorf. Analysis of the DTM (derived from LiDAR data) reveals the boundary ditch in relation to the deserted medieval villages of Lovětín and Pfaffendorf. Image by the authors, based on data from ČÚZK.

Obr. 5. Analýza hraničního příkopu pomocí DTM (LiDAR) v okolí Lovětína a Pfaffendorfu. Analýza DTM (odvozené z dat LiDAR) odhaluje hraniční příkop ve vztahu k zaniklým středověkým vesnicím Lovětín a Pfaffendorf. Vytvořeno autory na základě dat z ČÚZK.

This approach has also proven effective in other studies focusing on deserted settlement structures and field systems, where hillshade highlights archaeological anomalies and topographical details (e.g. Mazáčková et al. 2016; Kolomazníček 2021; Holata–Malina 2024).

For the non-invasive documentation of boundary stones, 3D photogrammetry was employed, based on the principles of Structure from Motion (SfM) and Multi-View Stereo (MVS). This technique enables the creation of metrically accurate 3D models from digital photographic data. In the field, a series of photographs of each object was taken from multiple angles using a digital camera. Crucial for successful reconstruction was ensuring sufficient image overlap, typically 60–80 % for adjacent images. These images were subsequently processed automatically using Agisoft Metashape Professional software. The process involved image alignment, dense point cloud generation, and the creation of a photorealistic mesh model with high-resolution texture. The resulting 3D models precisely captured the shape of the stones, including fine details such as engravings (Yakar et al. 2022). The data were published on the Sketchfab platform (see Web references).

To document the spatial position of the boundary stones in the field, GNSS measurements were conducted using Real-Time Kinematic (RTK) mode (Orynassarova et al. 2022) with a Trimble R12i device. This instrument utilises multifrequency signals from all global navigation satellite systems (GPS, GLONASS, Galileo, BeiDou) and, thanks to the integration of an Inertial Measurement Unit (IMU), enables measurement at pole inclinations of up to 15° without requiring any vertical alignment. The Trimble R12i achieves a horizontal accuracy of approximately 2–3 cm (median) and vertical accuracy within 5 cm (median), even under challenging conditions such as dense forest canopy. Measurements are conducted in real-time, using corrections obtained

from a reference station network (e.g., CZEPOS or IMAX), with typical signal fix times of under 10 seconds (Table 1).

Two magnetometers were employed during the research depending on terrain conditions. LEA MAX magnetometer (Eastern Atlas, Germany) was used in opened fields, consisting of a gradiometer equipped with ten fluxgate probes (FEREX CON 10, Förster, Germany), with data processed in the LEAD2 software. In more demanding terrain, such as undulating landscapes and forested areas, a Förster FEREX 4.032 DLG magnetometer (Förster, Germany) with four FEREX CON 650 fluxgate probes were used. Data from these devices were evaluated using MagproLight and Surfer 13, while ArcGIS PRO was employed for the final interpretation and presentation (Havelka–Milo 2022, 9–10).

The aim of the prospection was to detect potential traces of undocumented settlement in the vicinity of the Petrchovský Pond.

6 Results and discussion

6.1 Boundary continuity and functionality

An analysis of the Digital Terrain Model (derived from LiDAR data) and its visualisation using a hillshade feature revealed the course of the oldest section of the historical boundary, with a total length of 10.7 km. This line included a 6.4 km long segment of a boundary trench, while the remaining section followed natural watercourses. The boundary ditch is most clearly visible on the DTM visualisation in the area between the cadastral territories of Třešť and Otín, where it is also best preserved in the terrain (Fig. 5).

The boundary trench was examined at three specific locations to assess its dimensions. The first part of the trench, situated near boundary stone No. 7, measured 2.62 metres in width and 0.52 metres in depth. The second part, located adjacent to boundary stone No. 24, exhibited a width of 2.16 metres and a depth of 0.44 metres. The third part of the trench, recorded in the vicinity of boundary stone No. 31, measured 2.20 metres in width and 0.41 metres in depth. These measurements indicate that the trench maintained relatively consistent dimensions along the course of the boundary.

The course of the boundary was verified along its entire length through a field survey comprising a GNSS coordinate recording for each boundary stone found within the line. Measurements were performed using a Trimble R12i device, which enabled high-precision data collection even in challenging terrain. The field survey achieved a firm accuracy: a median horizontal accuracy of 2.9 cm (mean 10.2 cm) and a median vertical accuracy of 4.1 cm (mean 15.2 cm). A total of forty-two boundary stones were recorded along the line demarcated in 1557, with an additional five stones marking the boundary established in 1614 between the village of Stajiště (Třešť estate) and Otín (Jihlava estate; Supplementary Table 1).

Subsequently, the obtained spatial data were compared with the Franciscan cadastral maps from 1835 and the current records of the Cadastre of Real Estate. This comparison was conducted by georeferencing the historical maps within ArcGIS Pro 3.5.0, enabling a detailed analysis of the boundary preservation and its position shifts in the present-day landscape (Fig. 3).

As part of a 3D photogrammetric survey, selected boundary stones with specific markings (e.g., No. 7 – the year 1557; No. 31 – “57”; No. 8 – the mark of a Jihlava councillor; No. 20 – “Fride”), were photo-documented and converted into 3D models using Agisoft Metashape Software. This approach allowed detailed visualisation of the stone’s engravings (Supplementary Table 2) and ensured a high level of information conservation related to their historical appearance. The models were published on a freely accessible platform, Sketchfab (See links in the Web references). This approach allowed for a detailed visualization of the engravings and ensured that information about the stones’ historical appearance, which is threatened by erosion and human activity, was preserved at a high level.

In the Czech context, such a well-documented early modern administrative boundary is exceptional. The rarity of this case, however, does not lie solely in its continuity but in the extensive

Tab. 1. Coordinates, dimensions and evidence number of boundary stones recorded by GNSS survey.

Tab. 1. Souřadnice, rozměry a evidenční čísla hraničních kamenů zaznamenaných GNSS měřením.

Coordinates, dimensions and evidence number of boundary stones recorded by GNSS survey									
Boundary stone number	“Y [m] (S-JTSK Krovak EastNorth 2018 SW)”	“X [m] (S-JTSK Krovak EastNorth 2018 SW)”	“Z [m] (S-JTSK Krovak EastNorth 2018 SW)”	Height [cm]	Length [cm]	Depth [cm]	Evidence Number	Note:	Number of Crosses
1	-674323,977	-1144044,869	666,872	50	24	8	N/A	1614	1
2	-674360,113	-1143913,961	667,869	62	37	19	74	N/A	1
3	-674292,050	-1143796,253	663,960	55	42	47	73	1617	1
4	-674427,092	-1143745,013	665,016	64	26	14	71	N/A	0
5	-674565,127	-1143649,392	667,518	123	42	23	68	N/A	1
6	-674581,742	-1143523,725	671,641	33	37	25	63	N/A	1
7	-674519,234	-1143493,843	669,940	44	65	22	N/A	1557	1
8	-674467,069	-1143447,988	671,468	37	62	25	61	Mark	1
9	-674355,590	-1143362,370	660,303	43	27	24	60	N/A	3
10	-674269,812	-1143306,410	658,457	38	38	20	59	N/A	2
11	-674184,556	-1143238,318	651,844	57	35	28	58	N/A	1
12	-674145,895	-1143210,143	649,196	47	66	23	57	1557	2
13	-674069,760	-1143172,298	647,114	31	47	27	56	N/A	1
14	-674017,195	-1143147,756	647,006	88	32	22	55	N/A	1
15	-673925,282	-1143058,814	648,182	41	31	28	54	N/A	1
16	-673886,733	-1142665,799	653,264	62	52	17	47	1557	2
17	-674046,868	-1142256,583	635,906	94	27	20	40	N/A	2
18	-674061,621	-1142222,323	633,459	27	50	34	39	N/A	1
19	-674077,705	-1142187,487	631,389	42	44	14	38	N/A	1
20	-674086,854	-1142159,202	628,805	107	42	27	N/A	FRIDE	3
21	-674178,983	-1142043,490	618,279	67	50	25	30	1557	2
22	-674212,526	-1141972,913	608,494	53	35	23	29	N/A	1
23	-674253,782	-1141915,350	606,114	80	38	25	28	N/A	1
24	-672649,002	-1140081,212	570,908	60	40	30	N/A	1557	1
25	-672843,588	-1139656,622	584,355	20	25	22	38	N/A	1
26	-672917,094	-1139579,968	585,754	44	44	10	37	N/A	1
27	-673405,983	-1139277,309	599,315	34	40	24	34	N/A	1
28	-674866,545	-1139359,520	618,579	64	12	11	68	N/A	1
29	-675042,325	-1139358,234	626,509	40	21	17	65	N/A	1
30	-675143,492	-1139309,578	632,009	82	63	17	63	1557, Mark	2
31	-675242,942	-1139050,224	651,835	61	32	27	59	57	1
32	-675258,234	-1139023,407	653,801	64	17	14	58	N/A	1
33	-675277,763	-1138968,499	658,303	97,5	19	12	57	N/A	1
34	-675278,922	-1138938,386	661,525	50	39	23	56	N/A	2
35	-675277,663	-1138866,348	666,746	87	22	14	55	N/A	1
36	-675272,123	-1138831,817	667,762	48	33	23	54	N/A	2
37	-675191,965	-1138438,424	670,219	48	43	27	46	N/A	2
38	-675277,062	-1138325,522	670,693	57	20	13	42	N/A	1
39	-675332,878	-1138120,059	659,032	80	65	50	38	N/A	0
40	-675423,789	-1137898,473	654,428	80	37	40	N/A	N/A	1
41	-675430,199	-1137896,011	653,405	70	33	47	36	N/A	0
42	-675435,365	-1137816,869	652,148	75	24	40	N/A	N/A	1
43	-675444,132	-1137757,310	650,626	116	90	30	33	N/A	1
44	-675481,750	-1137676,655	647,197	138	44	40	30	N/A	1
45	-675509,465	-1137657,285	645,198	47	35	26	29	N/A	2
46	-675605,271	-1137598,766	639,573	72	56	43	27	N/A	1
47	-675672,325	-1137017,078	622,700	84	70	35	10	N/A	1

Tab. 2. Additional information on crosses at each boundary stone.**Tab. 2. Další informace o křížích u jednotlivých hraničních kamenů.**

Additional Crosses information for each boundary stone		
Boundary stone number	Number of Crosses	Cross notes
1	1	On the top side of the stone, next to the year 1614, clearly visible, deeply engraved
2	1	On the top side of the stone, below number 74, clearly visible, deeply engraved, rather small, side endings distorted
3	1	On the back side of the stone together with number 73, hardly visible, shallowly engraved
4	0	
5	1	On the top side, above the number 68, clearly visible, deeply engraved, endings distorted
6	1	On the front side, clearly visible, deeply engraved, right endings distorted
7	1	On the top side, clearly visible, shallowly engraved, right endings distorted
8	1	On the top side, clearly visible, deeply engraved, all endings distorted, on the front side combined with mark of councillor "Sulle"
9	3	First cross: On the front (top part) together with number 60, the largest one, quite deeply engraved, though its arms are slightly distorted at the ends; Second cross: On the right side, located roughly in the middle of the stone, smaller and less prominent; Third cross: On the back side, faint but still recognizable
10	2	First cross: Faint, shallow cross (about 10 cm) is visible in the center of the stone above the number 59; Second cross: shallow small cross on the middle top side of the stone
11	1	On the upper top side, clearly visible, above the number 58
12	2	First cross: above the year 1557 on the middle top side, shallowly engraved; Second cross: small, on the middle back side of the stone together with number 57
13	1	On the top side, clearly visible, deeply engraved
14	1	On the upper top side, clearly visible, deeply engraved, all endings distorted
15	1	Large, on the front side next to number 54, clearly visible, deeply engraved, center of the cross large and distorted
16	2	First cross: large one above the year 1557 on the middle top side, deeply engraved; Second cross: small, on the top side of the stone together with number 47
17	2	First cross: slightly red-colored deeply engraved, on the back side, in about $\frac{3}{4}$ of the height of the stone; Second cross: slightly red-colored deeply engraved, on the back side, in about $\frac{1}{4}$ of the height of the stone
18	1	On the center top side next to number 39, clearly visible, endings disproportional
19	1	On the bottom front side below number 38, clearly visible, bottom endings hidden in the terrain
20	3	First cross: On the top portion of the stone. It's large, plainly carved, with fairly straight arms. Ends are mostly preserved (not very distorted), but weathering has softened edges. Second cross: On the right side, mid-height. Smaller and shallower than the first; less distinct. Third cross: On the back face (or rear side). Faint; carving is shallow and partly eroded, harder to see.
21	2	First cross: deeply engraved, on the front side, in about half of the height of the stone, slightly above and next to the faintly and shallowly engraved year of 1557; Second cross: on the back side of the stone, slightly below half of the stone, shallowly engraved
22	1	On the center top side, clearly visible
23	1	On the upper top side, clearly visible, deeply engraved, above number 28
24	1	On the center top side, clearly visible, shallowly engraved
25	1	On the center front side, clearly visible, deeply engraved, bottom ending disproportional
26	1	On the center top side, hardly visible, shallowly engraved, next to number 37
27	1	On the right top side, clearly visible

Additional Crosses information for each boundary stone		
Boundary stone number	Number of Crosses	Cross notes
28	1	On the center top side, clearly visible, symetrically shallolwly engraved
29	1	On the center top side, clearly visible, symetrically shallolwly engraved
30	2	First Cross: On the upper front side above the year 1557 and next to number 63, clearly visible, shallolwly engraved; Second cross on the left top side, clearly visible and deeply engraved. Slightly bigger than the first one
31	1	On the bottom front side, upper ending is splitting the number 57, clearly visible, deeply and nicely engraved
32	1	On the center top side, clearly visible, symetrically shallolwly engraved
33	1	On the center top side, clearly visible, symetrically shallolwly engraved
34	2	First cross: large whitish deeply engraved, on the front side, in about half of the height of the stone above number 56; Second cross: much smaller, shallowly engraved on the right side of the stone
35	1	On the center top side, clearly visible, symetrically shallolwly engraved
36	2	First cross: deeply engraved on the front side below the number 54, the bottom end hidden in terrain; Second cross: smaller, shallowly engraved on the middle top side of the stone
37	2	First cross: Near the center, larger and deeper, clearly engraved on the front side with number 46; Second cross: Below the first, smaller and fainter on the right side of the stone
38	1	On the center top side, clearly visible, symetrically shallolwly engraved
39	0	
40	1	On the front side, clearly visible, symetrically shallolwly engraved
41	0	
42	1	On the left side, clearly visible rather small and symetrically shallolwly engraved
43	1	On the right top side, clearly visible rather small, shallolwly engraved above number 33
44	1	On the top side, clearly visible rather small next to number 30, shallolwly engraved
45	2	First cross: On the front side, above the engraved number 29, medium-sized and clearly visible; Second cross: On the top side of the stone, clearly visible
46	1	On the right upper side, clearly visible rather small next to number 27, shallolwly engraved
47	1	On the right top side, clearly visible having number 10 in south-western end, shallolwly engraved

preservation of its physical markers and the rich archive record. This makes it possible to conduct further economic studies of early industrialisation of the landscape and to examine its role in the sustainability and resilience of Early Modern society. However, it is not an isolated phenomenon. Similarly, long-term stable boundaries have been documented elsewhere as well, for example, in Poland, their continuity can be traced back to 1254 in the area of present-day Western Pomerania (Przybyła 2022, 131–132). Research in Slovenia has likewise confirmed the endurance of a later boundary established in 1726 (Triglav Čekada 2023, 340–341). The stability of these boundaries has endured not only the dissolution of feudal entities but also subsequent shifts in political and administrative structures. Such results suggest that the persistence of historical boundaries may be significantly more widespread in Europe than traditionally assumed.

6.2 Boundary as a driving force of socio-economic change

The boundary emerged within a context of significant socio-economic transformations, specifically the decline of silver mining and the rise of agriculture as the primary economic driver. The

Jihlava and Třešť estates began to focus on acquiring the surrounding villages and territories that had previously belonged to the deserted settlements. LiDAR-derived DTM data enabled the identification of two deserted villages – Lovětín and Pfaffendorf – within whose hinterlands the boundary was later demarcated (Fig. 5). In addition, geophysical surveys recorded three settlement features below the Petřichovský Pond, arranged at regular intervals (approximately 50 meters apart). Although their parcel layout corresponds to the pattern known from Lovětín (12 strips), their widths differed significantly (Fig. 4). These villages, deserted at the turn of the 15th and 16th centuries, played a key role in defining administrative spheres of influence in the area. The land divisions of the economic hinterlands thus left a visible trace on the landscape long after the settlements themselves had disappeared.

The main contribution of this research lies in the possibility of reconstructing the now-non-existent administrative boundaries of deserted villages. By combining non-destructive methods with archive and cartographic sources that link the studied boundaries to historical land use, it is possible to gain insight into the past organisation of the landscape. In this way, the boundary becomes a key indicator of institutional memory, landscape stability, and the resilience of historical structures in the present environment.

7 Conclusion

This article answered the main research questions posed at the beginning. It confirmed that the boundary's functionality and continuity have persisted since its establishment in the 16th century to the present day. This was demonstrated through the integration of non-destructive survey methods (LiDAR, DTM, GNSS, 3D photogrammetry) aligned with historical maps and archive sources. The study also highlighted and confirmed the boundary's key role in shaping socio-economic relations, legal frameworks, and territorial structures, showing it to be a resilient element of institutional memory and spatial organisation.

The results showed that the 16th-century boundary has survived without severe alteration and continues to serve its original function as an administrative and cadastral demarcation between the town of Třešť and the surrounding villages. Subsequent boundary sections established in 1614 and 1653 reflect the same developmental pattern. This stability testifies to the enduring influence of medieval and early modern legal structures in the present-day landscape, being traceable over nearly five centuries.

The situation nowadays is more challenging due to the denser division of forest land parcels. This fragmentation complicates coordination and rapid response to issues such as drought or bark beetle infestations, often leading to extensive logging, which destroys not only the cultural landscape but also biodiversity and natural wildlife habitats. This highlights the crucial need for a deeper understanding of the historical and present-day landscape structures and their interconnections to sustainability, resilience, and cultural heritage protection.

Future research will further explore the deserted villages and their connection to mineral extraction as integral elements in the broader processes of colonisation and landscape transformation.

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Souhrn

Půl tisíciletí kontinuity: odolná hranice v české kulturní krajině a její dopad na socio-ekonomický rozvoj

Tato studie se zaměřuje na pozoruhodnou, téměř pět set let trvající kontinuitu raně novověké hranice mezi někdejšími jihlavským a třeštským panstvím na Českomoravské vrchovině. Tato více než 10 km dlouhá hranice, vyznačená příkopy, kameny, mezníky a přírodními prvky, byla potvrzena kameny datovanými do roku 1557, což z ní činí jednu z nejstarších doložených hranic na území českých zemí. Kombinací moderních nedestruktivních metod (LiDAR, DTM, 3D fotogrammetrie, GNSS) a analýzy archivních a kartografických pramenů byla hranice detailně zdokumentována a její průběh přesně zmapován v prostředí ArcGIS Pro.

Výsledky potvrzují, že hranice nejen přečkala zrušení poddanství v roce 1848, ale nadále ovlivňuje i současné katastrální uspořádání. Výzkum rovněž odhalil souvislosti mezi historickou hranicí a socioekonomickými proměnami regionu, zejména v souvislosti s rozvojem těžby stříbra a zemědělství. Hranice odráží dlouhodobou institucionální a územní kontinuitu, která formovala vnímání prostoru i právní regulace v rámci místní společnosti.

Studie dále ukazuje, že taková dlouhodobá stabilita hranic není výjimečná a lze ji nalézt i v dalších evropských regionech, což naznačuje širší význam historických hranic jako trvalých struktur v kulturní krajině.

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