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Neolithic (4850–4500 BCE) Rondel Enclosures in Central Europe: A Curated Geospatial and Structural Dataset

DATA PAPERS

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ABSTRACT

Spanning Central Europe in the first half of the 5th millennium BCE, Neolithic rondel enclosures (NRE) mark the inception of monumental building traditions in the area. The steep rise in newly identified sites in recent years makes it difficult to analyse and understand this phenomenon to the full extent. Therefore, we present the dataset covering all currently known 261 NREs dispersed on the territory of several present-day states. Excerpted from literature and supplemented with recent discoveries, the dataset describes precise geospatial position, key construction elements, and the state of research for each NRE. Comparable contemporary enclosures and structures previously misinterpreted as NREs are also presented. The dataset offers a foundation for detailed spatial analyses and supports deeper investigation into the development, distribution, and significance of NREs.

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(1) OVERVIEW

CONTEXT

Circular enclosures—commonly referred to as rondels or *Kreisgrabenanlagen*—became a hallmark of the Neolithic period in Central Europe. Featuring one or more concentric ditches, inner trenches, elaborate entrances, and other architectural elements, these structures often reached monumental dimensions and required substantial labour investment. The rondel phenomenon emerged in the first half of the 5th millennium BCE, at a time when multiple archaeological cultures coexisted across Central Europe. Although these groups are primarily distinguished by differences in pottery styles, domestic architecture, and mortuary practices, they share a common origin in the preceding Linearbandkeramik culture (5400–5000/4900 BCE). Simultaneously, extensive exchange networks of various materials attest, along with rondels, to sustained connectivity across the region [1].

Despite six decades of intensive archaeological research, the origin, function, activities taking place inside, as well as the appearance of Neolithic rondel enclosures (hereafter NRE) remain subjects of ongoing debate. Scholars have developed several major lines of interpretation (see overview in [2]). However, studies focused on individual sites or limited regions have proven insufficient to capture the full complexity of the rondel phenomenon, even when supported by large-scale excavations and advanced analytical approaches. A broader, integrative perspective is required.

Already in the 1980s, it became evident that NREs represent a widespread phenomenon. They have been documented across today's Austria, Czechia, Germany, Hungary, Poland, and Slovakia. The number of identified sites steadily increases, driven by advances in non-invasive surveys that have significantly expanded the corpus over the last two decades. Recent discoveries have further extended the known distribution of NREs into previously unexpected areas, including Slavonia in Croatia [3] and the western bank of the Rhine [4].

Given the rapid pace of discovery, even relatively recent studies that aspired to catalogue all NREs [2, 5, 6] are now outdated, listing only between 137 and 182 enclosures. This situation underscores the urgent need for an updated and systematically compiled inventory. Moreover, the fragmentation of scholarship along national and linguistic boundaries has left many sites underrepresented in the broader discourse, as they remain confined to local publications in different languages. In response, we present here a dataset compiled by an international team, offering a revised and comprehensive overview of the geospatial and structural characteristics of all currently known NREs in Central Europe.

SPATIAL COVERAGE

Description: The main dataset spatially encompasses the territory of Austria, Croatia, Czechia, Germany, Hungary, Poland, and Slovakia. The NREs were dispersed over an area of approximately 415,000 km^2. Boundary coordinates are given in the World Geodetic System (WGS) 1984 (EPSG: 4326).

Northern boundary: 53.11816
Southern boundary: 45.14068
Eastern boundary: 19.48139
Western boundary: 6.89999

TEMPORAL COVERAGE

The NREs are generally dated between ca. 4850 and 4500 BCE. Nevertheless, the chronology of the phenomenon is estimated slightly differently by various authors (e.g. [2, 7, 8]). Due to wide geographic distribution, NREs permeate various regional periodisation systems, resulting in their classification as Middle, Late, and even Early Neolithic depending on the area.

(2) METHODS

STEPS

We chose to list individual NREs rather than group them under archaeological sites, as these are often defined inconsistently and lack clear boundaries. The list of NREs previously published by J. Řídký and colleagues (Table 4.1 in [2]) has been revised, expanded, and supplemented with precise geographical coordinates. Each regional revision was carried out by designated author(s) to ensure thorough engagement with local literature and data. Rondel locations, specifically the central points of the circular enclosure, were extracted from published sources and verified using open-access map portals. Finally, we unified the terminology used throughout the dataset, as local research communities have developed distinct terminological frameworks. We adopted the term *Neolithic rondel enclosure* (NRE) as the most broadly applicable designation while remaining sufficiently specific to refer to this characteristic mid-5th-millennium BC phenomenon. For the description of the NRE components, we employed a simplified and standardised terminology (ditch, inner trench, outer trench, entrance; see descriptions below).

QUALITY CONTROL

The Neolithic rondel enclosure is defined here using the attribute set proposed by J. Petrasch [9], amended to reflect subsequent advances in research:

1) circular or almost circular ground plan with an empty interior
2) one or more ditches with V- or Y-shaped cross-section and an earthen embankment on the outside
3) one or more interior, likely palisade trenches
4) one to four, or occasionally more, entrances leading into the interior
5) settlement traces (pits, houses) located outside the enclosure

6) integration of NRE into a broader system comprising settlements, cemeteries, and sometimes other enclosures within a microregion

Despite the established definition, not all cases are clear-cut, as not every attribute is necessarily present or identifiable. The fuzziness of the general classification is particularly exposed in the border areas of distribution, where the NRE phenomenon interferes with diverse cultural and enclosure traditions. On one hand, some formal differences are pointed out, but these enclosures might perform functions comparable to NREs. In the west, the pseudo-ditch Rosheim type of enclosures [10] share some of the NRE attributes and derive from the same Linearbandkeramik tradition. Similar classification challenges arise in the Carpathian Basin, where NREs meet with various types of other Neolithic enclosures, some surrounding flat settlements and tells, others more closely resembling NREs (e.g., [11, 12, 13]). Future research will likely need to reassess our current understanding and definition of NREs, and the dataset presented here offers a valuable starting point for such efforts.

Even when considering the fuzziness of J. Petrasch's definition, a wide range of enclosures and earthworks dated (at least in part) between 4850 and 4500 BCE cannot be confidently classified as NREs, as these structures do not align with their key attributes. Examples include enclosures with substantial evidence of internal occupation (e.g., Rechnitz 4, Sormás-Törökföldek 2) or circular palisades without ditches (e.g., Plotiště nad Labem 1, Quenstedt, Žlkovce-Vaniga). These NRE-like structures are presented in a separate file that follows the format of the main dataset (2_NRE_like_and_potential.csv). Here, we also committed the recent discoveries from Smilčić in Croatia [14] and Borđoš in Serbia [15]. Although these enclosures display many NRE characteristics, their relationship to the phenomenon remains unclear. Further research is needed, especially given their location far beyond the presently assumed NRE distribution and the slightly earlier chronology of the Borđoš enclosure, which predates 5000 BCE.

Given that circular enclosures occur across the entire span of Prehistory, the risk of misinterpretation is considerable. For example, the enclosure at Pietrowice Wielkie in Poland, for a long time classified as an NRE, has been re-dated to the Bronze Age [16]. These enclosures and earthworks previously identified in the literature as NREs but later reinterpreted in light of new evidence are listed in a separate file (3_non_NREs.csv) to minimise the continued citation of outdated attributions. It should be noted that a certain potential for re-dating remains for sites in our main dataset that have not yet been excavated. This is particularly relevant for simple, single-ditched enclosures lacking diagnostic NRE features, such as outward-inverted gates.

CONSTRAINTS

The expected positional deviation of the central points of NREs recorded in the dataset is generally no greater than ±5 m for preserved rondels identifiable through remote sensing data. This deviation may be larger for already destroyed NREs known only from older excavations without reliable geolocation. The reliability of records concerning NRE construction attributes likewise depends on both the state of research and the preservation of each enclosure. Narrow trenches—usually interpreted as palisades located inside, and in some cases also outside, the ditch circuit—are detectable through geophysical prospection but can be confirmed with confidence only through excavation. The identification of additional outer enclosures surrounding a broader area around the NRE is similarly conditional. Their visibility depends heavily on the spatial extent of the survey, as geophysical investigations usually focus on the NRE itself and seldom extend into its wider surroundings. As a consequence, such outer elements can remain undetected.

For this reason, we adopted a rigorous approach: architectural attributes were marked as uncertain (?) or expressed as minimum values whenever the state of research was insufficient to provide conclusive data. Furthermore, the dataset documents the research status for each enclosure (remote sensing, geophysical survey, and excavation or test trenching), so users can independently evaluate the reliability and interpretative confidence associated with each record.

(3) DATASET DESCRIPTION

The main dataset comprises 261 NREs distributed across the territories of seven present-day states (Table 1). While the highest abundance has traditionally been identified in the Lower Austria–Southern Moravia area, recent discoveries have revealed additional concentrations of NREs in eastern Bohemia, the Carpathian foothills of western Slovakia, and southeastern Transdanubia (Figure 1). In some microregions, the NRE distribution follows the course of water streams, resulting in string-like arrangements. This pattern is most clearly expressed along the lower Isar River in Bavaria, on the right bank of the upper Elbe River in Bohemia, and along the lower Kamp River in Lower Austria (Figure 2). It remains unclear whether such configurations represent local peculiarities or instead reflect broader distributional tendencies made visible by intensive prospection within these microregions.

In any case, groupings of NREs are not exceptional: 79 enclosures (30%) belong to so-called multirondel sites, defined as a group of at least two enclosures situated within one kilometre of each other [7]. The most prominent example is Kyhna in Saxony, where six NREs (ID 166–172) are concentrated within less than 40 hectares. Whether such multirondel sites represent

STATE/REGION	Σ
Austria	**65**
Burgenland	5
Lower Austria	58
Upper Austria	2
Croatia	**9**
Slavonia	9
Czechia	**72**
Bohemia	51
Moravia	21
Germany	**42**
Bavaria	15
Brandenburg	1
Lower Saxony	1
North Rhine-Westphalia	3
Saxony	18
Saxony-Anhalt	4
Hungary	**29**
Central Hungary	1
Central Transdanubia	1
Southeastern Transdanubia	17
Western Transdanubia	10
Poland	**14**
Chełmno Land	1
Kuyavia	1
Lower Silesia	11
Western Pomerania	1
Slovakia	**30**
Western Slovakia	30
Total	**261**

Table 1 Overview of NREs distribution in particular areas of Central Europe.

contemporaneous complexes or diachronic sequences of constructions remains a matter of ongoing debate [7, 17, 18] and future studies.

The spatial distribution of construction attributes is highly variable, underscoring the polythetic character of the NRE phenomenon [19]. Yet, several patterns emerge. The maximum diameter of the outermost ditch could be reliably estimated for 253 NREs (97%). Values vary substantially, ranging from 22 at Warburg-Daseburg (ID 187) to 310 m at Villánykövesd-Jakabfalusi út mente (ID 215). Nevertheless, the majority fall between 67 m (lower quartile) and 120 m (upper quartile). It seems that the NREs in the southeastern regions of their distribution, namely in the Carpathian Basin, tend to exhibit larger maximum dimensions (Figure 3). A similar trend is observed in the number of ditches. Western Slovakia provides evidence of NREs with five ditches (Figure 4A), and at least six ditches have been proposed for the NRE in Žitavce-Nad hlbokým jarkom (ID 261, excluded from the map due to uncertainty). Even so, single-ditched NREs also occur within the Carpathian Basin, indicating that large and multiply-ditched enclosures represent a tendency rather than a rule.

The identification of entrances is significantly constrained by both the state of research and preservation; reliable estimates are available for only 127 NREs (49%). Among these, the number of entrances most commonly ranges between two and four, although examples with six and eight entrances are also documented (Figure 4B). The large NRE at Villánykövesd-Jakabfalusi út mente (ID 215) may have between seven and thirteen entrances, as suggested by a geophysical survey. At least sixteen entrances have been proposed for the NRE at Hopferstedt (ID 160; both cases were excluded from the map due to uncertainty). However, it remains unclear whether all identified interruptions represent actual entrances or instead result from unfinished ditch construction, highlighting the interpretative ambiguities that persist even in well-investigated NREs.

The number of internal circular trenches does not exceed three, but their number can be reliably estimated only for 106 cases (41%). Trenches situated on the outer side of the ditch circuit are much less frequent, being recorded only in nine cases. Additional enclosing elements around NREs, either in the form of narrow palisade trenches (e.g. Těšetice-Kyjovice, ID 133) or more substantial ditches (e.g. Künzing-Unternberg 1, ID 166), are identified at 26 NREs (10%), but this attribute can be assessed with confidence for only 173 cases (66%). No clear spatial patterning of additional enclosures is currently evident, except for a concentration of five enclosed NREs (out of eleven) in the lower Isar River microregion in Bavaria (Figure 4C).

A total of 221 NREs (85%) remain largely preserved, i.e. not substantially affected by modern disturbances such as transport infrastructure. Remote sensing methods play a key role in their identification, as 78% of NREs can be detected through aerial survey or satellite imagery, typically thanks to crop- or soilmarks indicating the course of ditches. A distinct category comprises NREs whose ditches and ramparts are sufficiently well preserved to remain visible to the naked eye at ground level or in LiDAR imagery. This group is limited to eight cases, all located in woodland environments unaffected by agriculture: Niederhollabrunn (ID 27), Obermakersdorf 1–2 (ID 31–32), Sommerein 1–3 (ID 51–53), Švábenice (ID 131), and Třebovětice (ID 134). A geophysical survey has been conducted at 161 NREs (62%). The most detailed level of investigation—full excavation or at least test trenching—has been undertaken at 110 NREs, representing 42% of the dataset (Figure 4D).

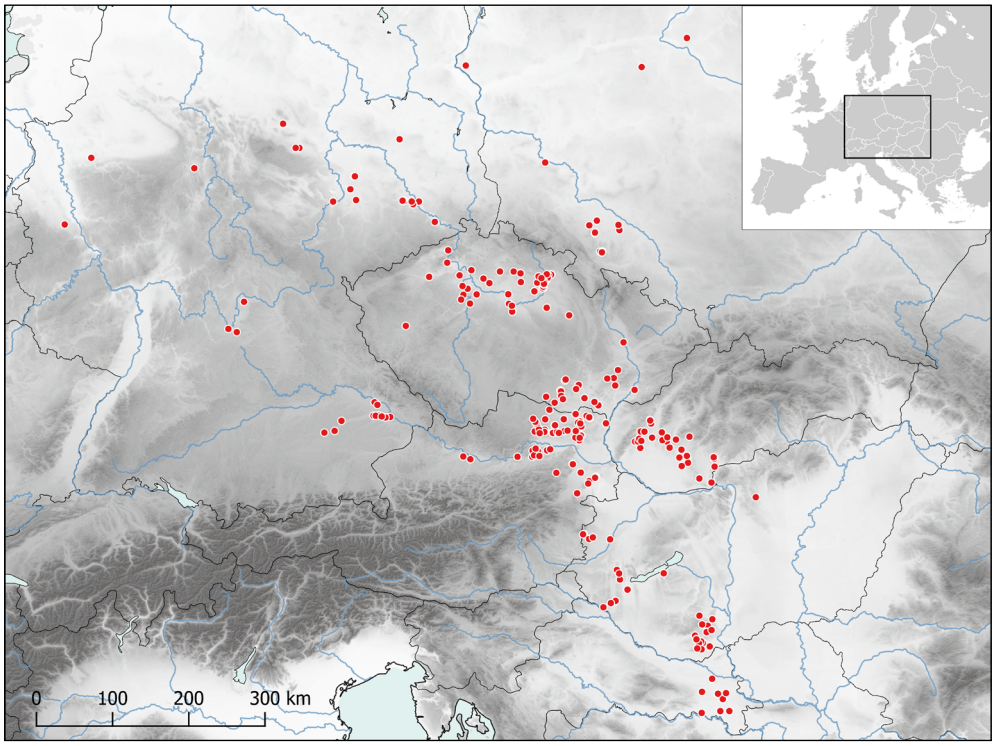

Figure 1 Overview map of NREs in Central Europe.

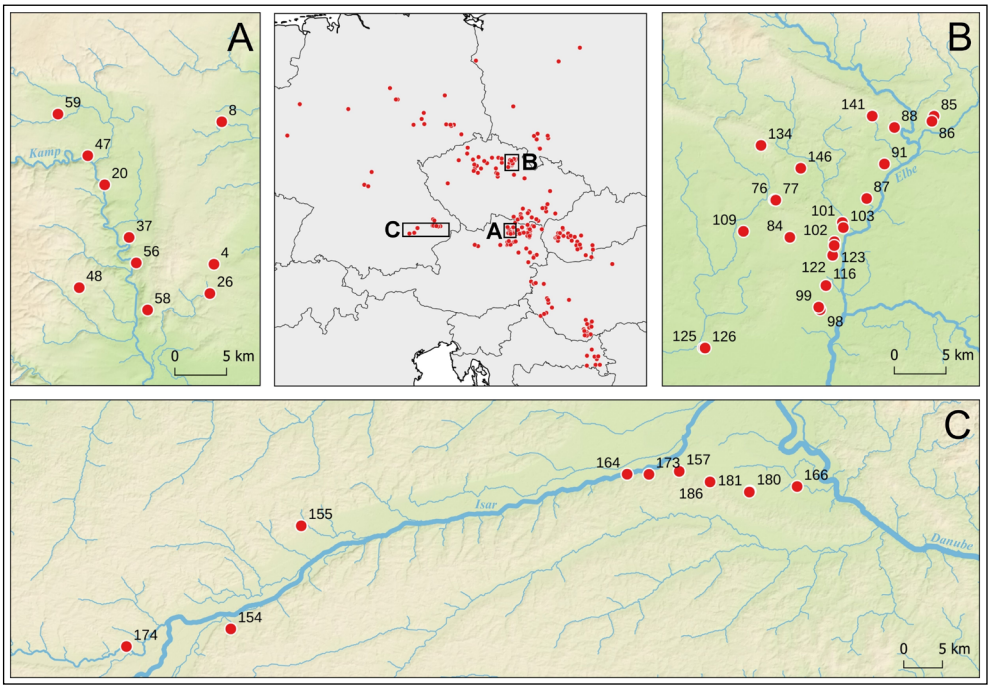

Figure 2 Details of string-like distribution patterns formed along watercourses. **A**: lower Kamp River (Austria); **B**: right bank of the upper Elbe River (Czechia); **C**: lower Isar River (Germany).

OBJECT NAME

1_NREs.csv
2_NRE_like_and_potential.csv
3_non_NREs.csv
References.pdf

DATA TYPE

The dataset consists predominantly of secondary, processed data compiled from published literature (for a full list of sources, see References.pdf). In several cases, previously unpublished enclosures have been included, based on the authors' own research or shared through personal communication with other scholars.

Dataset variables:

ID

Primary numerical key assigned by the authors; not derived from the literature or any other source.

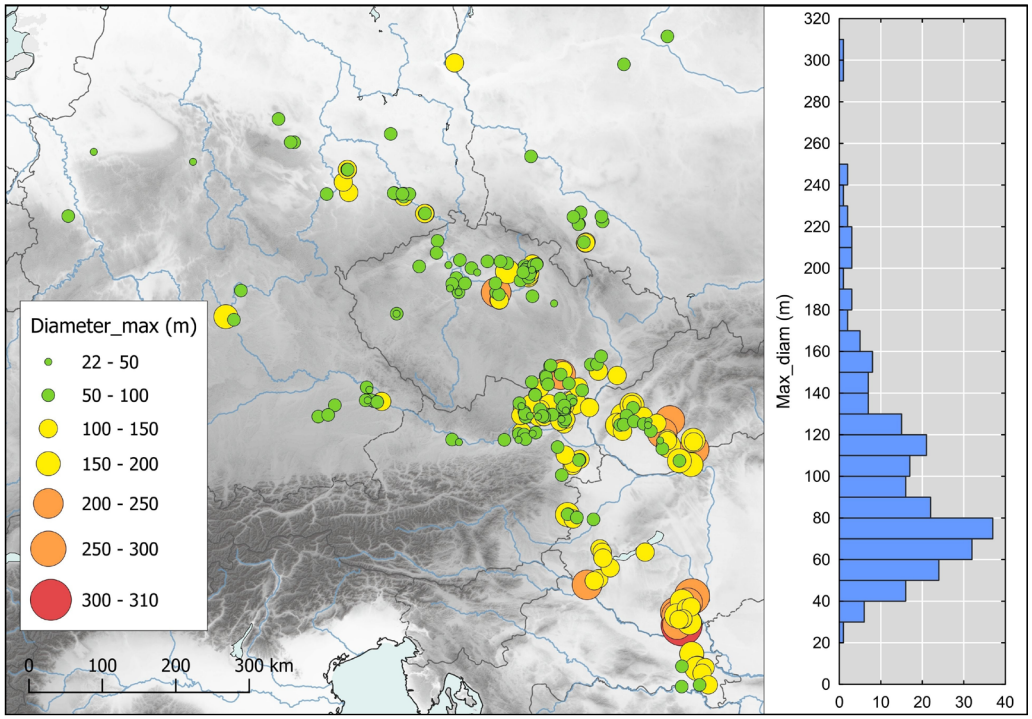

Figure 3 Maximal diameters of ditches and their spatial distribution. Size symbols are scaled in 50 m intervals.

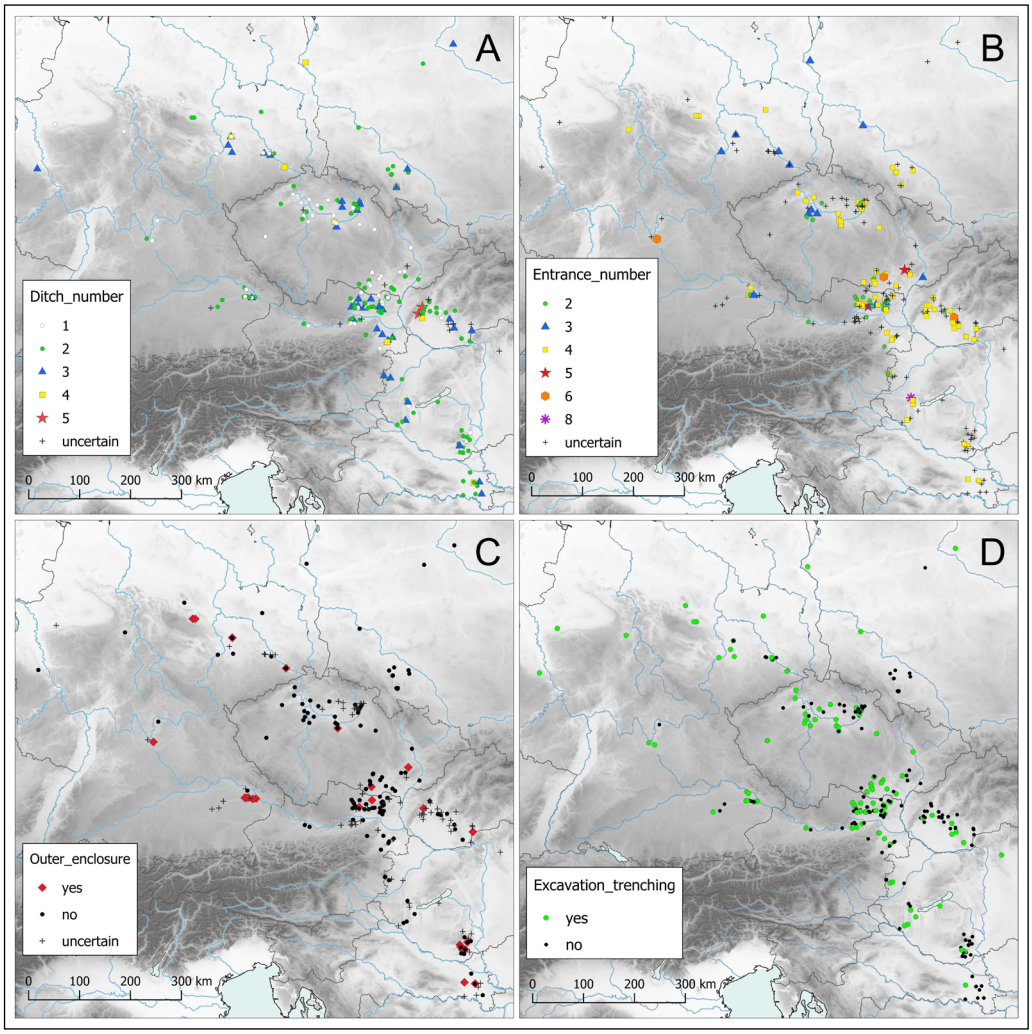

Figure 4 Spatial distribution of key NRE structural and research attributes. **A**: number of ditches; **B**: number of entrances; **C**: additional enclosure surrounding the NRE; **D**: Excavation or trenching of the NRE.

State
Localisation of the NRE according to the state.

Region
Localisation of the NRE according to the historical or geographical regions of Central Europe.

Name
The name of the NRE following the site name established in archaeological literature. When a single site features multiple enclosures, Arabic numerals were added to distinguish between them.

District
Localisation of the NRE according to the district, county, or similar administrative unit applied in the respective state.

Culture
Cultural affiliation of the NRE. In cases when cultural affiliation was not verified by excavation or at least by surface survey at the site, the affiliation is stated with a question mark, being typically based on the regional context. Abbreviations: GG – Grossgartach; LGK – Lengyel; MOG – Moravian Painted Ware; PF – Planig-Friedberg; ROS – Rössen; SBK – Stichbandkeramik; SOB – Südostbayerisches Mittelneolithikum/Oberlauterbach; SOP – Sopot.

*Ditch*_number
The number of rondel ditches.

Ditch_number_note
Qualifier indicating uncertainty in the number of ditches.

*Diameter*_max
The diameter of the largest ditch. Measured at the central point of a ditch width and given in meters. Note that this figure may be only approximate in the case of unexcavated rondels.

*Diameter*_max_note
Qualifier indicating uncertainty in the diameter of the largest ditch.

Trench_in_number
The number of circular trenches inside the central area of the NRE.

Trench_in_number_note
Qualifier indicating uncertainty in the number of inner trenches.

Trench_out_number
The number of circular trenches on the outer side or between the ditches.

Trench_out_number_note
Qualifier indicating uncertainty in the number of outer trenches.

Entrance_number
The number of entrances.

Entrance_number_note
Qualifier indicating uncertainty in the number of entrances.

Outer_enclosure
An additional ditch/trench enclosure surrounds the NRE. Y – yes, N – no, ? – unknown or uncertain.

Remote_sensing
The NRE can be identified by aerial survey, satellite imagery, LiDAR or other remote sensing methods. Y – yes, N – no, ? – unknown.

Geophysics
The NRE was examined by geophysical methods. Y – yes, N – no, ? – unknown.

Excavation_trenching
The NRE was excavated or at least verified by limited trenching. Y – yes, N – no, ? – unknown.

Preserved
Most of the NRE area is currently preserved and has not been significantly disturbed by modern infrastructure. Completely or largely archaeologically excavated rondels are considered preserved. Y – yes, N – no, ? – unknown.

Reference
Reference to the literature giving the most comprehensive information on the NRE.

WGS_N; WGS_E
Geographical coordinates of the centre of the NRE in the World Geodetic System (WGS) 1984 (EPSG: 4326) given in the decimal degrees format [XX.XXXXX].

Note
Additional information about the NRE.

FORMAT NAMES AND VERSIONS

CSV, PDF

CREATION DATES

The dataset was created between July 2024 and April 2026.

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LANGUAGE
English

LICENSE
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REPOSITORY LOCATION
https://doi.org/10.5281/zenodo.23738404.

PUBLICATION DATE
Version 1.1.0 of the dataset was published on 28/10/2026.

(4) REUSE POTENTIAL

The dataset enables not only straightforward mapping of NRE sites but a wide range of advanced spatial analyses. Because each NRE is recorded with precise geospatial coordinates, the dataset is suitable for GIS applications such as viewshed modelling, least-cost path analysis, clustering, and network analyses. It also supports detailed spatial examination of constructional attributes and architectural trends. The current set of formal descriptors can be further extended, for example, by adding entrance-related variables such as construction type and orientation to expand the analytical possibilities. More broadly, the dataset provides a foundation for reassessing the definition of NREs and their diagnostic characteristics, thereby contributing to a more comprehensive understanding of the enclosing phenomenon in Neolithic Europe.

Beyond Neolithic archaeology, the dataset is valuable for specialists in the remote sensing of archaeological structures. It facilitates the analysis of ditched-enclosure visibility in aerial and satellite imagery acquired under varying environmental and seasonal conditions, as well as in LiDAR datasets.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Designated authors were responsible for collecting and revising data within specific regions: Austria – David Ruß; Croatia – Hrvoje Kalafatić, Bartul Šiljeg, and Rajna Šošić Klindžić; Czechia – Jaroslav Bartík, Václav Vondrovský, and Jaroslav Řídký; Germany – Joachim Pechtl and Harald Stäuble; Hungary – Kata Furholt; Poland – Mirosław Furmanek; Slovakia – Tibor Lieskovský and Jana Mellnerová Šuteková. The text and figures were compiled by Václav Vondrovský.

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