

WEB DATABASES, DATA ANALYSIS AND MODELLING IN ARCHAEOLOGICAL RESEARCH

Bronze Age Socio-Economic Strategies in the Central Danube region: a digital database

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One of the greatest scientific and social challenges of the 21st century in all disciplines is the storage, structuring, modelling, interpretation, and publication of large, complex research data sets (big data). Archaeological research is no exception. Over the past two decades, this discipline has developed through much more intensive cooperation with life and natural sciences than before, and is now faced with the exponential growth and expansion of data. This is evidenced by the fact that archaeology in our era, after it emerged at the end of the 19th century and subsequently faced with the so-called radiocarbon revolution that defined the second half of the 20th century, is now referred to by international research as the Third Science Revolution in connection with the enormous amount of data awaiting interpretation and the impact of new methods on archaeological research (KRISTIANSEN 2014; KRISTIANSEN 2025). Without claiming to be exhaustive, we are reviewing some international trends and related domestic initiatives. The latter include the databases created by the MTA–BTK Lendület “Momentum” BASES Research Group.

Keywords: databases, Bronze Age, settlement networks, bioarchaeology, absolute chronology, metallurgy

DATABASES IN ARCHAEOLOGICAL AND HISTORICAL STUDIES

A principal task in the field of databases and data repositories is the creation of dynamic web applications based on research data, which can also serve as tools for comprehensive and exploratory research covering larger regions, such as the overview processing of prehistoric metalworking or the mapping of raw material sources used from the European Neolithic to the Iron Age (Fig. 1; ROSENSTOCK et al. 2016; KERIG et al. 2023). Interna-

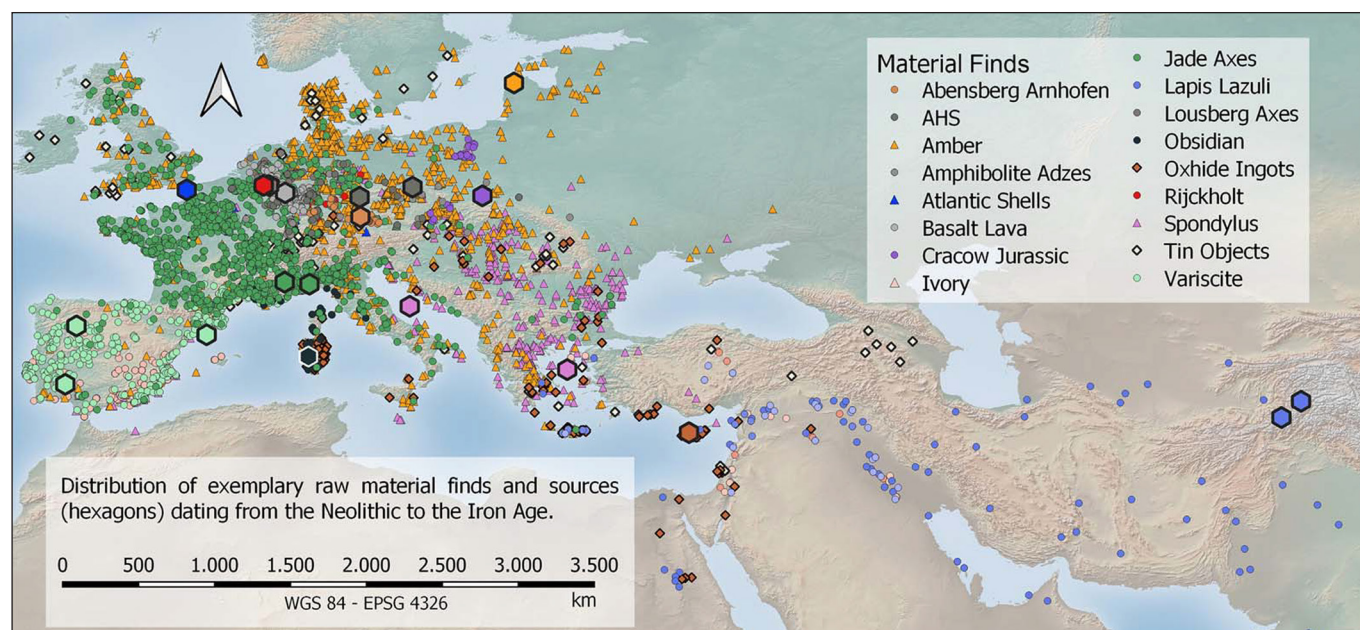


Fig. 1. The Big Exchange project with more than 6,000 raw material sources from the Neolithic until the Iron Age (KERIG et al. 2023, Fig. 1)

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☐	ID	Lab Code	Lab Nr.	BP	Std	δ 13C	Sample Mat.	Feature Type	Culture	Phase	Site	
☐	717	Erl	4662	3240	54		collagen, bone	grave	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Harthausen b. Feldhausen; site: Bühl Hgl. 1	Show Calibrate
☐	718	Erl	4670	3110	58		collagen, bone	grave	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Harthausen b. Feldhausen; site: Bühl Hgl. 1	Show Calibrate
☐	821	Erl	4667	3227	58		collagen, bone	grave (inhumation)	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Hundersingen; site: Weidenhang Hügel	Show Calibrate
☐	1021	UIC	11339	3107	45		collagen, bone	grave (inhumation)	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Kleinprüfening; site: Buchschlag	Show Calibrate
☐	1171	Erl	4668	3132	55		collagen, bone	grave	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Mehrstetten; site: Oberes Häule Hgl. 2	Show Calibrate
☐	1285	UIC	11341	2914	41		collagen, bone	grave (cremation)	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Nersingen-Leibi; site: Steinegert	Show Calibrate
☐	2021	UIC	11338	3149	37		collagen, bone	grave (mound) inhumation	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Unterbrunnham; site: Wagenau Hgl. 16	Show Calibrate
☐	2022	UIC	11340	3249	41		collagen, bone	grave (inhumation)	Tumulus culture (Hügelgräberbronzezeit)	Tumulus Bronze Age C1	Untermeitingen	Show Calibrate

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Fig. 2. Samples from the Rado.NB database (<https://radonb.ufg.uni-kiel.de/dates>)

tionally, there are numerous initiatives in the field of archaeology, including archaeological databases aimed at collecting chronological, bioarchaeological, and archaeometric data. In addition to archaeological databases, we draw attention to major international data portals and some historical geographical database systems.

1. Chronological data collections: one of the first online databases was the open access RADON portal created in 2000, which contains data on the chronology of the prehistoric period in Central Europe and Scandinavia, mainly carbon-14 dates from the Neolithic and Early Bronze Age (<https://radon.ufg.uni-kiel.de/>; revisited in 2014: <https://radonb.ufg.uni-kiel.de/dates>; RINNE et al. 2014). The advantage of the database is that BP (before present) data can be immediately recalibrated according to the built-in, up-to-date calibration curves (Fig. 2). A world-wide collection with 350 thousand radiocarbon dates is the XRONOS database (<https://xronos.ch>).

2. Large international data portals: the Ariadne portal (<https://www.ariadne-research-infrastructure.eu/>), supported by the European Union, stores more than four million archaeological and heritage protection

ARIADNE PORTAL

Filters

All fields Search 3,982,583 resources...

Where

When

Results

Time: 0.7s. Total: 3,984,376. Page: 1 / 199

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BO IVO Gieten Middendorp Bureauonderzoek en Inventariserend veldonderzoek - verkennende en karterende fase Middendorp 21 te Gieten, gemeente Aa en Hunze (DR)

Laagland Archeologie heeft in oktober 2019 een Bureauonderzoek en Inventariserend veldonderzoek - verkennende en karterende fase uitgevoerd aan de Middendorp 21 te Gieten. Het onderzoek vond plaats in verband met de ruimtelijke procedure rondom de bouw van een dubbele woning. Het bureauonderzoek had tot doel een archeologisch verwachtingsmodel op te stellen. Centraal staat daarbij de vraag of en zo...

Resource type: Fieldwork archive
Place: Gieten, 12g (kaartblad), Drenthe, Aa en hunze, Middendorp 21
Publisher: Data Archiving and Networked Services (DANS)
Original subject: Archaeology

Data from Historic Building Recording and Archaeological Monitoring and Recording at Mount Pleasant Methodist Chapel, New Mills, Derbyshire, 2021-2023.

This collection comprises images, plans, reports and site records from historic building recording and archaeological monitoring and recording carried out by Archaeological Research Services at Mount Pleasant Methodist Chapel, New Mills, Derbyshire, from February 2021 to March 2023. The photographic record of the walls of the Mount Pleasant Methodist Chapel built in 1893 represents comprehensive p...

Resource type: Building survey
Publisher: Archaeology Data Service
Original subject: Building recording, Building survey, Church buildings, Field observation (monitoring), Methodist chapel

Images and GIS Data from the Analytical Building Recording of Gasholder No. 3, Hendon Gasworks, Hendon, Sunderland, Tyne and Wear, 2022-2023.

This collection comprises images and GIS files from a comprehensive analytical buildings record (Level 4) of the internal elements of a gasholder at the former Hendon Gasworks, Hendon, Sunderland. This work was undertaken by Headland Archaeology (UK) Ltd during October 2022...

Resource type: Building survey
Publisher: Archaeology Data Service
Original subject: Building recording, Comprehensive analytical buildings record (level 4), Excavations (archaeology)-recording, Gas holder, Gas holder building

Fig. 3. Search interface of the Ariadne portal (<https://www.ariadne-research-infrastructure.eu/>)

data from forty countries on four continents; it includes excavation documentation, laboratory test data, and publications (Fig. 3). Its aim is to integrate existing archaeological data infrastructures (so-called grey literature) so that, using new technologies, interested parties can access otherwise scattered archaeological data through a unified system. The multi-level *Archeodatabase* system of the Hungarian National Museum, accessible to the general public and researchers at different levels of detail, is also part of and a partner in this large European database (<https://archeodatabase.hnm.hu/>; KREITER, 2019).

3. Among the archaeological and bioarchaeological data collections on burials, one example is the Austrian *Thanados* database (<https://thanados.net/entity/127381>), which contains archaeological and anthropological data on early medieval grave finds and is based on the *OpenAtlas* system (EICHERT 2014). Between 2019 and 2022, data on all published early medieval cemeteries in Austria were entered into the open access database. Graves and finds can be displayed on integrated maps (Fig. 4). Participants cooperate with the ERC Synergy *HistoGenes* project, which is implemented as part of an American–German–Austrian–Hungarian collaboration, incorporating complex bioarchaeological data from 6,000 early medieval (between 400 and 900 AD) burials into the database (<https://www.histogenes.org/>). A new system has been developed to record the data of the latter project, which is available as a cloud-based service on the *Airtable* platform, currently for researchers only. As another initiative, the *Cremation Bronze Age Burials* (CBAB) database aims to collect data on cremation burials in Central Europe during the Late Bronze Age (14th–9th centuries BC). The dataset, made available to researchers in 2018, currently contains published archaeological and archaeometric data on 913 burials in Austria, Croatia, and Serbia (<https://cbab.acdh.oeaw.ac.at/>).

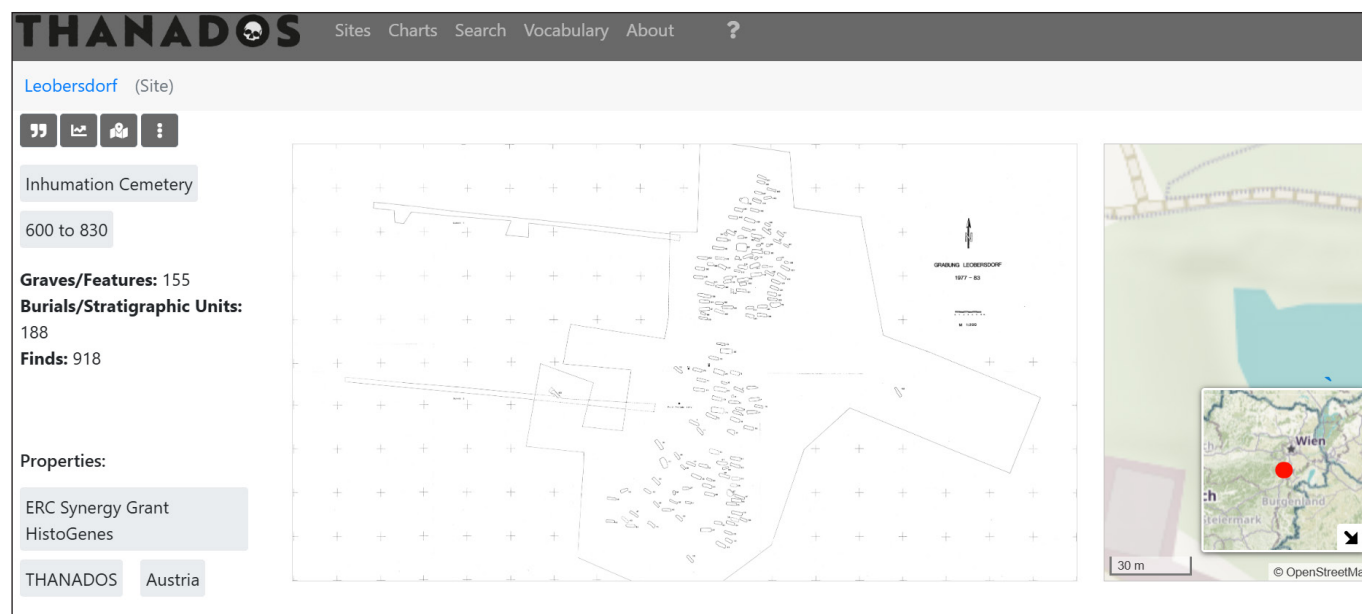


Fig. 4. Cemetery data from Leobersdorf in the *Thanados* database (<https://thanados.net/entity/127381>)

4. Databases containing archaeometric analyses include datasets of prehistoric stone tools from Hungary (T. BIRÓ et al. 2021) or international metal testing research programs. One example is the database of the University of Oxford's ERC FLAME (*Flow of Ancient Metals across Eurasia*) project, which collected the results of elemental composition and lead isotope analyses of European and Chinese bronze objects, as well as their chronological data (<https://flame.arch.ox.ac.uk/public-resources/>).

5. New-generation databases serve to identify multidisciplinary data connections and hidden patterns. Among them, the *Big Interdisciplinary Archaeological Database* (BIAD; <https://biadwiki.org/>) is of particular importance. It is developed by the ERC Synergy COREX project (From CORrelations to EXplanations: towards a new European prehistory; <https://www.gu.se/en/research/corex-from-correlations-to-explanations>) and its collaborating partners. The geographical scope of this continuously expanding, decentralized, MySQL-based relational archaeological database currently covers mainly Europe, but its long-

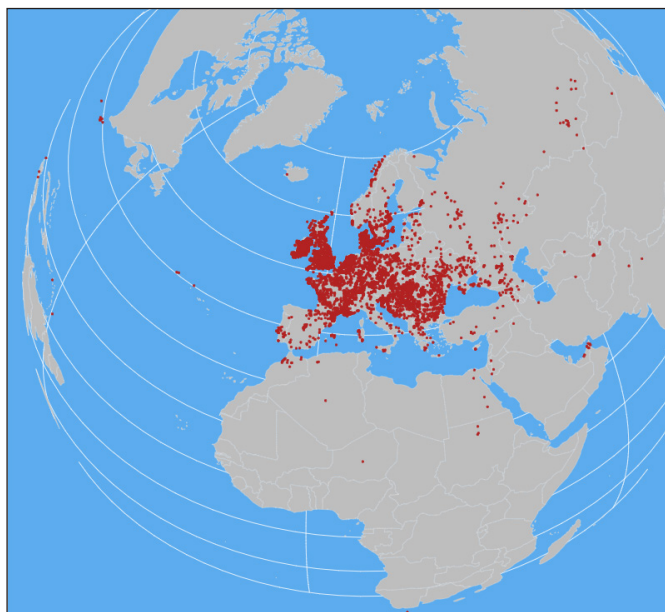


Fig. 5. Available sites in the BIAD database
(<https://biadwiki.org/>)

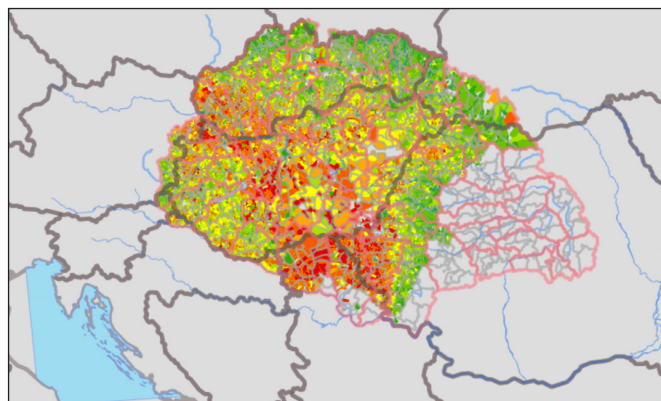


Fig. 6. GIS data Hungarorum database and digital map
(<http://gistahungarorum.abtk.hu/>)

archaeozoological, and material culture data sets) are linked, enabling cross-referencing and deeper data analysis. The data are linked using an SQL system: they can be queried using command line queries or SQL graphical user interface access (e.g., Sequel Pro) (REITER et al. 2024; STANIUK et al. preprint).

6. Historical geographic information systems (GIS): the *GIS data Hungarorum* database and digital map of Hungary and the wider Carpathian Basin (Fig. 6) were created in several time periods by specialists of history, ethnography, and geography, using the tools of geographic information systems to bring the databases to life (<https://gistory.hu>). The data series from the Dualism era has now been expanded with data from the 18th and 14th centuries (DEMETER et al. 2024).

THE DATABASES OF THE MTA-BTK LENDÜLET “MOMENTUM” BASES RESEARCH GROUP

The MTA-BTK Lendület “Momentum” BASES Research Group (<https://bazis.ri.abtk.hu/>) was launched at the end of 2023 with the support of the Momentum Advanced Programme of the Hungarian Academy of Sciences. One of the main objectives of the five-year-long project, entitled *BASES – Bronze Age Socio-Economic Strategies in the Central Danube region: a digital database (2500–1500 BC)*, is to digitally record the multidisciplinary research data of the MTA-BTK Lendület “Momentum” Mobility Research Group (2015–2023; <https://mobilitas.ri.abtk.hu>). Besides storing archeometric data, primarily derived from bioanthropology, isotope geochemistry, archaeogenetics, absolute dating, and material sciences (KISS et al. 2015; SZABÓ 2017; DANI et al. 2019a; KISS et al. 2019; KISS et al. 2021; CAVAZZUTI et al. 2021; ILON 2022; KULCSÁR et al. 2022; MELIS 2024; PÁSZTOR et al. 2024) in a repository, the other main goal is to analyse the datasets from a new perspective and publish them at multiple levels.

The project’s task for the first year was to develop the foundations of the four databases. A cloud-based *Airtable* system was used to compile the following data of the Bronze Age in Hungary (between 2500 and 1500/1400 BC):

1. the complex bioarchaeological data,
2. archaeometallurgical data on metal objects,
3. absolute chronological data,
4. micro-regional settlement networks (Fig. 7).

Among the first uploaded sites were the Bronze Age cemeteries at Balatonkeresztúr and Nagycenk, processed by the research group, as well as those at Gelej and Tiszafüred, which were evaluated and published

with the collaboration of the team (GÖMÖRI et al. 2018; GERBER et al. 2023; KISS et al. 2023; CAVAZZUTI et al. 2025). The available data will be further developed with knowledge on a topic that has been less researched so far, namely the economic resources of the period (e.g., data on the weight and raw material analysis of copper and gold objects; KISS & ROMHÁNYI 2023; DANI et al. 2024; DANI & KISS 2024; SZATHMÁRI et al., 2024) integrating this into our regional settlement network research (DANI et al. 2019b; KISS et al. 2021; MELIS et al. 2022; SZABÓ 2023).

Using models generated from the structured dataset, the project aims to reconstruct prehistoric socio-economic conditions in greater detail than ever before. This may open up new perspectives on the hidden networks of the lifestyles, diseases, nutrition, work habits, mobility, and family and social relationships of people and communities living four thousand years ago.

Based on the analysis and modelling of the large amount of complex data available, we also place emphasis on exploring previously unresearched scientific fields and questions. The four databases created also form the pilot project for the *Digital Archaeological Atlas of Hungary*, an initiative launched by the ELTE RCH Institute of Archaeology (before 31 July 2025: HUN-REN RCH Institute of Archaeology) containing thematic research data. This is not to be interpreted as a geographical atlas in the traditional sense, but rather as a repository of data related to specific research questions (KULCSÁR et al. in press).

International trends show that databases are no longer merely data repositories, but new types of research tools. The MTA–BTK Lendület “Momentum” BASES Research Group also keeps this in mind, so our project fits organically into European developments. Modelling results of databases can also provide a foundation for evaluating Bronze Age transformations in the Carpathian Basin in a broader Eurasian context.

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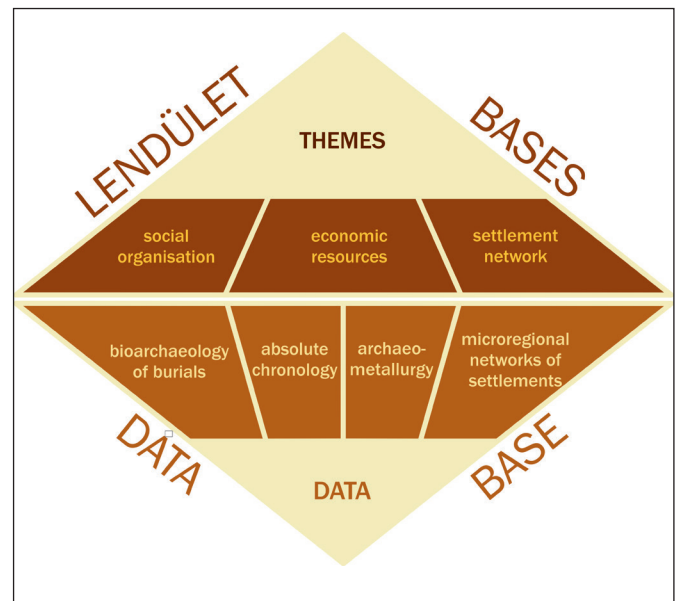


Fig. 7. Thematic groups and databases of the MTA–BTK Lendület “Momentum” BASES Research Group (graphics: Nóra Szabó)

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