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KILN DATABASE (KDB) PROJECT. CREATING KNOWLEDGE ON ANCIENT SOUTHWEST ASIA POTTERY FIRING TECHNOLOGY: THEORETICAL AND METHODOLOGICAL PROBLEMS

1. Introduction

The mastery of fire holds a fundamental place in the history of techniques and the pottery kiln, enabling the transformation of clay material into ceramic, stands as a significant milestone in this historical narrative. However, few considerations have been given to the uses and importance of pyrotechnologies in the ancient Southwest Asia societies (Rehder 2000; Padovani 2023c). According to Postgate (1983, 15), «the various hearths, ovens and kilns are of course among the most conspicuous features in any archaeological operation, with their violent colors, and are often clear to see when nothing else can be made out». Firing structures are clearly discernible on the field and do not necessitate cutting-edge excavation techniques, such as geophysical prospection or aerial imagery, for their identification. Therefore, the origin of the documentary gaps on the kiln and pottery production must be sought within the framework of the cumulative process of knowledge construction.

The objective of the paper is to explore the challenges archaeologists have encountered in constructing knowledge on ancient pyrotechnology since the beginning of archaeology in Southwest Asia in the 19th century, and to examine how contemporary digital tools can be employed to address these challenges.

The paper focuses on the development of the Kiln DataBase (KDB) Project as a case study (https://heurist.huma-num.fr/heurist/?db=kiln_mesopotamia&website&id=304). The KDB project was first designed as a PhD database on Heurist, gathering the description on 479 firing structures distributed on 50 sites dated from the 4th to the 3rd millennium BCE (Padovani 2023c) and ambitions to become a repository of knowledge on ancient pyrotechnology of Southwest Asia. The project's goals are: 1) to record and to categorise all available data on firing structures and workshop from the field or archives; 2) to be easily accessible online for external users; 3) to share as many pictures or plans of kilns in different states of conservation as possible to provide various elements for comparison and address identification problems in the field. For now, the website is operational but data access requires authentication through a password. The underlying inquiry of this preliminary assessment is to highlight the theoretical and methodological problems to create knowledge about ancient pottery firing technology, with the ultimate goal of implementing digital solutions to disseminate information to a wide audience, including both specialists and non-specialists. In other words, this paper investigates the effective conversion of personal data analysis into widely accessible, reusable knowledge.

In archaeology in general, this concern has a longstanding history (for further details and bibliography, referring to The Virtual Museum of Archaeological Computing, http://archaeologicalcomputing.lincei.it). In the 1960's, processual archaeologists initiated a reevaluation of the archaeological practices, focusing on methodological approaches and research design (Binford 1964; Binford, Binford 1968; Clarke 1968, 1973; Renfrew 1969). Additionally, Jean-Claude Gardin developed a 'logiscist' approach in archaeology aiming at standardising data description and interpretation processes to ultimately establish a universal knowledge base (Gardin 1958a, 1958b, 1962a, 1962b, 1987). He foresaw the development of artificial intelligence and the necessity for data to be accessible to both machines and humans, in accordance with the FAIR principles (Wilkinson *et al.* 2016). This approach was further pursued by Gallay (1977, 1989) and the Geneva University, where both Gardin and Gallay have taught.

Furthermore, within a broader context, scholars were conscious of the 'information explosion', referring to the proliferation of data and information in different languages, as well as the difficulties of staying informed of colleagues' work due to limited data accessibility. This challenge prompted UNESCO to commission a study on the feasibility of establishing a United Nations International Scientific Information System (UNISIST) to index scientific information (thesaurus, vocabularies, classification system) in order to facilitate data diffusion. Gardin (1970) was tasked with drafting the final report. This study needs to be situated within the backdrop of computer system advancements, capable of processing a large volume of data and making logical decisions. However, numerous and diverse information systems were being developed simultaneously, highlighting the issue of system compatibility, with the biblical reference to the Babel tower (Gardin 1970). The UNISIST report underscored that most developing countries lacked information centres to support such initiatives, while all countries faced economic, organisational and legal issues: «En l'absence de programme visant à diriger l'attention des gouvernants sur la nécessité de développer leurs ressources en information, les savants de nombreux pays subiront dans leur travail un handicap plus ou moins sévère. Cela sera particulièrement vrai des pays en voie de développement : le fossé qui sépare leurs connaissances théoriques et pratiques de celles des pays développés s'élargira inexorablement» (Gardin 1970).

These challenges remain highly relevant today (Moscati 2019, 2021). Since the 2000s, with the widespread adoption of personal computers, the expansion of Internet connectivity, and the more recent surge in artificial intelligence technology, the availability and the complexity of digital tools have significantly increased (Garstki 2024). Furthermore, recent discussions on equity in archaeological practice (for instance, the Annual conference of the BANEA 2024 - Archaeological and Heritage Practice in Southwest Asia: Towards Equitable Futures) have highlighted concerns regarding the exclusion of local archaeologists and communities in extra-European archaeology, particularly in the field of Southwest Asia archaeology (Porter 2010), attributed to inadequate data sharing practice. The approach developed for the KDB project will be presented, with an initial emphasis on identifying challenges in knowledge construction in general and in the historiography of pyrotechnology in particular, followed by the implementation of solutions informed by applied theoretical insights.

2. Construction of knowledge theory applied to archaeology

2.1 *From data to knowledge*

According to Ackoff's theory (1989), the process of knowledge construction can be depicted as a chain of interconnected stages, exemplified by the visually compelling yet controversial representation of a pyramid: the Data-Information-Knowledge-Wisdom hierarchy (or DIKW) (Fig. 1). Russell Lincoln Ackoff, a management consultant and professor of management science, created this model to demonstrate how data can be efficiently used to address practical challenges. He proposed a bottom-up approach of knowledge construction that helped to highlight issues related to knowledge organisation.

At the base of the pyramid, data are the outcomes of observations, corresponding to the description of entities archaeologists unearth during field excavation (e.g., observations: elongated brick alignment with reddened inner faces, ashy deposits containing sherds and bricks fragments). According to Ackoff, isolated data hold no value and require processing to become information. Data have to be condensed, contextualised, categorized. Information comes from a first step of interpretation that is carried out during excavation, resulting in the production of field reports in which archaeologists propose an interpretation of their observations (e.g., proposition 1: the brick alignment likely constitutes the external wall of a firing structure). All data are not always mobilised to produce the field reports, either because its significance may not be apparent at the time of drafting, or because it has yet to be recognised as information. Each archaeological mission employs its own data recording system (field journal, recording sheets, Geographic Information System, etc.), but photography holds significant importance. Actually, photographs serve as snapshots of the field situation

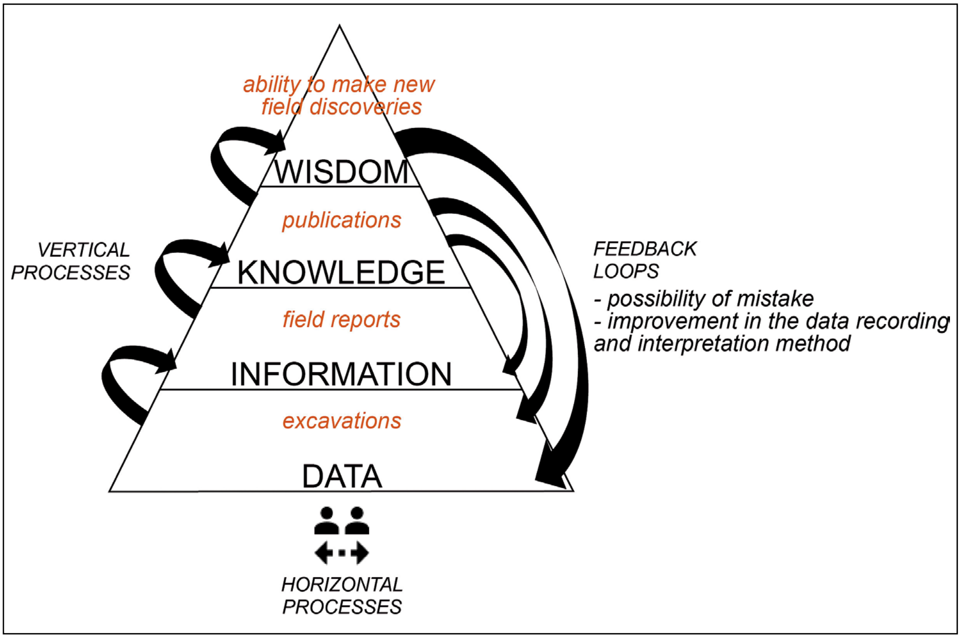

Fig. 1 – Ackoff's Pyramid and the archaeological process.

at a specific moment, capturing data in context before interpretation and transformation into information occur.

To generate knowledge, information must be evaluated, compared, connected. Information from several sites can be compared to draw inferences (e.g., observation+proposition 1 from various sites = elongated firing structures are characteristic of the 4th millennium BCE southern Mesopotamia). This constitutes the long-term research leading to scholarly papers and monographies. The pinnacle of Ackoff's pyramid is wisdom, in other words, the ability to make the wiser decision. However, from a scholarly perspective, the emphasis should be on using knowledge to make new discoveries and generate new data, thus returning to the base of the pyramid.

The vertical process of creating knowledge and wisdom is inherently non-linear, involving feedback loops between each layer of the pyramid (Fig. 1). Archaeologists are constantly negotiating between knowledge and data at every step of the interpretative process. Transforming data into information and knowledge implies a thorough understanding of data and the possibility of mistake and improvement of interpretation methods must be taken into consideration. Misinterpretation may occur despite the accuracy of the data or information, as archaeologists may lack the necessary insights for comprehensive understanding. Improvements in data recording and interpretation methods enable the extraction of additional or fresh information from existing data, thereby continually enhancing knowledge. Revisiting old data with newfound knowledge is a common practice. Gardin advocated for an interpretative method combining bottom-up (induction from data to knowledge) and top-down (deduction from knowledge to data) oriented approaches as a means of verification (Gardin 1979).

In addition to vertical processes, the importance of horizontal diffusion processes in knowledge construction should be underscored. Data and information are generated by various stakeholders and knowledge construction entails the use of dataset produced by different excavation teams. The quantity of data is just as crucial as its quality, as capacity to formulate accurate interpretations hinges on building knowledge from an extensive data foundation. Therefore, both the non-linear vertical construction and horizontal diffusion of data and information are intertwined in the knowledge-building process.

2.2 *Toward a current generic tool for research: open data, FAIR and CARE principles*

International legal directives, recognising access to data as a fundamental right, coupled with the rapid advancement of digital tools, have catalyzed the promotion of open data. It advocates for unrestricted access and reuse of data, without technical, legal, or financial barriers. The recent practice of open data was primarily focused on big data, meaning the accumulation of a high volume of raw data and the increase of storage capacity (Anderson 2008; Bollier 2010). However, archaeological data is inherently fragmentary, and what is excavated on the field is already interpreted by archaeologists and can't be considered as unprocessed. As noted by Schiffer (2010, 80), «the behavior of the archaeologist is the greatest source of variability in the archaeological record». For instance, in ancient Southwest Asia, the upper walls of most architectural constructions were usually made of mudbrick, with a material similar to their surrounding filling. Then, the dimensions of a mudbrick, even its existence, are contingent upon the archaeologist's ability to recover and interpret the vestiges. Similarly, the identification of a structure exhibiting firing marks as a potter's kiln is subject to interpretation. As emphasized by Ackoff's pyramid, data is «produced by disciplinary practices and identity processes and discourses» (Hamilakis 2003, 107). Therefore, the context and method of data production are crucial to interpret data and revise the interpretation when necessary and constitute key elements of the open data practice.

In 2016, the FAIR guiding principles for scientific data management and stewardship were published, for «improving the infrastructure supporting the reuse of scholarly data» (Wilkinson *et al.* 2016). These principles propose strategies for data management, suitable for any implementation solution, aiming to enhance: 1) Findability, data should be assigned a unique identifier and be registered in a searchable database; 2) Accessibility, data must be retrievable through their identifier using an open and free protocol; 3) Interoperability, data should be formalised using a broadly comprehensive language with well-defined vocabulary; 4) Reusability, data must be richly described (generous in metadata about provenance) and released with a clear license.

In addition, archaeological knowledge should not remain the exclusive domain of a selected group of specialists. In Southwest Asia archaeology, local archaeologists, local communities and the general audience often find themselves excluded from scientific debates due to limited or nearly inaccessible data, attributed to disparities in research tools. In extra-European archaeology, if archaeological objects remain within the country where excavations take place, there may be a lack of specific legislation addressing data management transparency. Archaeological missions store data and transform it, without systematically adequately informing local archaeologists and communities. Without access to scientific publications, they are left to rely on scattered field reports or uncontextualised and partial knowledge, unable to verify methods and sources or construct their own understanding (for an initiative that seeks to solve this problem, see OpenContext: https://opencontext.org/projects-index/).

The globalisation of western ideas and tools, even if locally inaccessible, have constrained the ability of local communities to sustain their own knowledge and data system (Smith 2012; Kukutai, Walter 2015; Kukutai, Taylor 2016; Carroll *et al.* 2019, 2020). As foreseen by the UNISIST report in the 70's, this issue stems from a developmental disparity between European and Southwest Asia countries regarding data management. Nevertheless, local Iraqi communities possess tools to store data repository and preserve local knowledge (The Academic Research Institute in Iraq, 1989, in Bagdad and Erbil: https://www.tarii.org/, Zheen Archive Centre, 2004, in Souleymanieh: https://zheen.org/en/about/).

In 2020, the CARE principles were published to «integrate Indigenous knowledges and approaches into data practices and policies as both the volume and opportunities for secondary use of data increase» (Carroll *et al.* 2020, 2). CARE principles gather: 1) Collective benefit, data should achieve inclusive development and innovation; 2) Authority to control, data should be accessible to local communities who must be involved on the stewardship; 3) Responsibility, data should serve to enhance the capability and capacity of local communities; 4) Ethics, data should be accessible to local communities and benefit them.

3. Kiln historiography: identifying the vertical and horizontal biases in the construction of knowledge

The beginnings of archaeology in Southwest Asia is closely tied to the political influence of France, Germany, and England. The first archaeologists were often members of official diplomatic delegations, as they were among the few individuals permitted extended stays in these territories. The first French excavation started in 1842 in Iraq under the guidance of Paul-Émile Botta, the French consul in Mosul. Until the eve of the Second World War, archaeological endeavours relied heavily on state funding, with the expectation of retrieving remarkable artifacts for exhibitions in western museums (Chevalier 2002). This historical context underscores the trajectory of archaeological undertakings in the early 20th century. The search for aesthetically pleasing objects and the challenges associated with mudbrick excavation, led archaeologists to focus on the most prominent and material-rich structures such as palaces and temples. As a result, firing structures were relatively neglected, depending on the sensibilities of expedition directors.

Drawing from ethnographic observations in Egypt and Afghanistan, Matson (1974) supposed that kiln areas were often associated with necropolises. Kilns were considered too polluting, intrusive or lacking informational value about ancient societies and potters were supposed to be spatially isolated and poorly integrated into the social fabric. Consequently, firing structures were generally not excavated but rather delineated plans, or mentioned in excavation reports. This omission resulted in a lack of information and standardised terminology for understanding and differentiating kilns, furnaces and hearths.

However, in 1938, Ghirshman was the first to propose an evolution of the pottery kiln, based on a specific kiln excavated at Sialk III. Nevertheless, he lacked access to data concerning other dated firing structures in Southwest Asia and outlined a linear evolution – later proven to be false – from open firing (pots covered with fuel without any constructed structure), to an increasingly distinct separation of the combustion chamber and the firing chamber. Overall, the disinterest in pyrotechnology and the impossibility to share and compare data created a dearth of data, misinformation, and ignorance, hindering the pursuit of new insights. In the 1960s, as interest in the archaeology of techniques grew, firing structures began to grab the attention of archaeologists. However, they were often regarded as isolated objects, detached from the archaeological context. They were described separately from the other remains. Two parallel trends in study emerged: one focusing on the function, and the other on the morphology of firing structures.

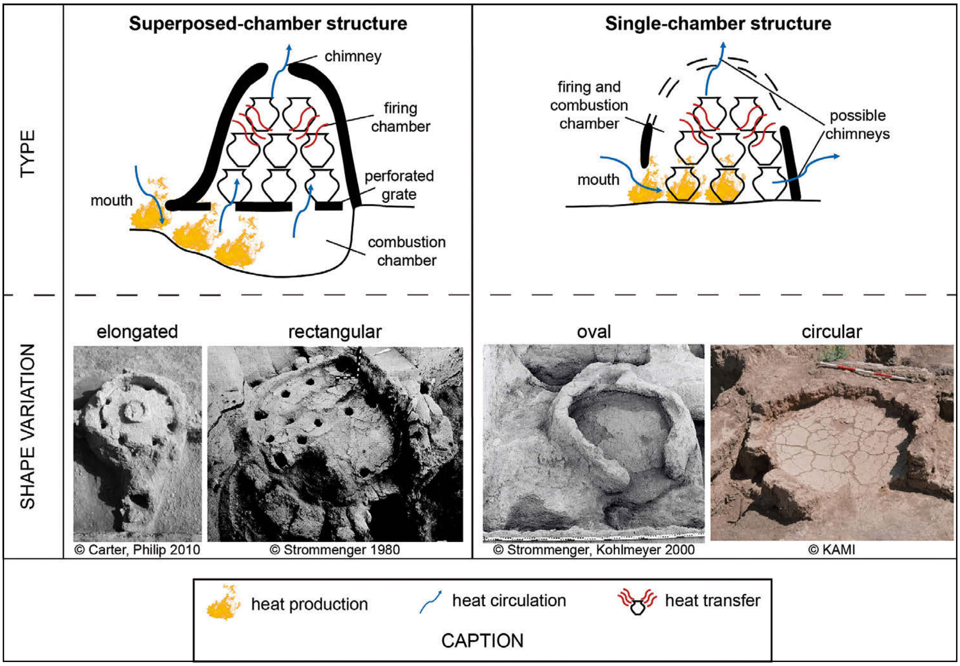

Fig. 2 – Two firing structure types and example of their shape variation illustrated by archaeological specimens (ph. C. Padovani).

From the 1960s to the early 1990s, archaeometric analyses were undertaken to determine the highest temperature achieved during the firing process. The higher the temperature, the more the kiln was considered to be efficient, marking the level of technical development of the social group employing it (Roberts, Radivojevic 2015). Consequently, the examination of firing structure morphology was frequently overlooked. From the 80s, the hypothesis widespread that kilns were a specific adaptation to environmental conditions. Unlike hearths, kilns were believed to enable pottery firing year-round, even in rainy conditions (Rye, Evans 1976; Arnold 1985; Meadow 1991). Researchers focused on how protohistoric societies could produce functional ceramic products without taking into account the distinct characteristics of firing structures or the agency of the potters. It was not until the 1990s that experimentation challenged the prevailing belief that kilns aimed to reach higher temperatures than open hearths (Gosselain 1992; Livingstone Smith 2001).

In the 1970s, only a handful of studies, unrelated to archaeometric analysis, have delved into the morphology of firing structures and stand as the only references available on the subject (Delcroix, Huot 1972; Majidzadeh 1975). They proposed a linear development of the firing structure, from less efficient to more efficient forms (Padovani 2024). The performance was interpreted on the supposed capacity to reach higher temperatures (for instance, by covering or burying the structure). However, even the simplest firing structure, as the open-hearth, can achieve the temperature necessary to fire the late chalcolithic and early Bronze Age pottery (between 500 and 800°C). Therefore, the performance is not a suitable criterion for characterising firing structures. The lack of communication between specialists in the two scientific trends, the absence of contextualisation of archaeological data, and the failure to question the true nature of firing structures as technical objects independent of their environment resulted in incomplete information and knowledge.

Since the 2000s, firing structures have been systematically excavated and documented in their context (Hansen Streily 2000). Nevertheless, data were still widely scattered and their study reached a methodological dead-end. Archaeologists were confronted to a very high diversity of shapes, without being able to highlight any regional or chronological pattern of diffusion (Boroffka, Becker 2004). Therefore, the philosophy of techniques and the works of G. Simondon (1958) in particular, are useful to understand the nature of firing structures and propose a method of classification (Padovani 2023a, 2023b, 2024). This approach considers firing structures as systems characterised by an arrangement of functional units. The whole structure is dedicated to firing ceramics, but each functional unit within the structure has its own technical function: heat production, heat circulation, or heat transmission. Depending on the arrangement of these units within the structure (for example, between a kiln with superposed chambers where the heat production unit is below the heat transmission unit and a single-chamber structure, where the heat production unit and the heat transmission unit are combined), the method of transmitting heat to the clay material differs (Fig. 2). Therefore, a specific structural arrangement or what can be called 'type', corresponds to a specific firing method. Moreover, two kilns of the same type may have different shapes.

4. Theory into practice: building a base of knowledge

4.1 *Findability*

To address the lack of contextualisation identified in pyrotechnology knowledge construction, the database does not focus on kiln *per se*. Instead, it gathers, in a same location, a detailed description of the architecture of the firing structure (available on 85% of sites), general information about the site, and when available (on 44% of sites), details about the crafting

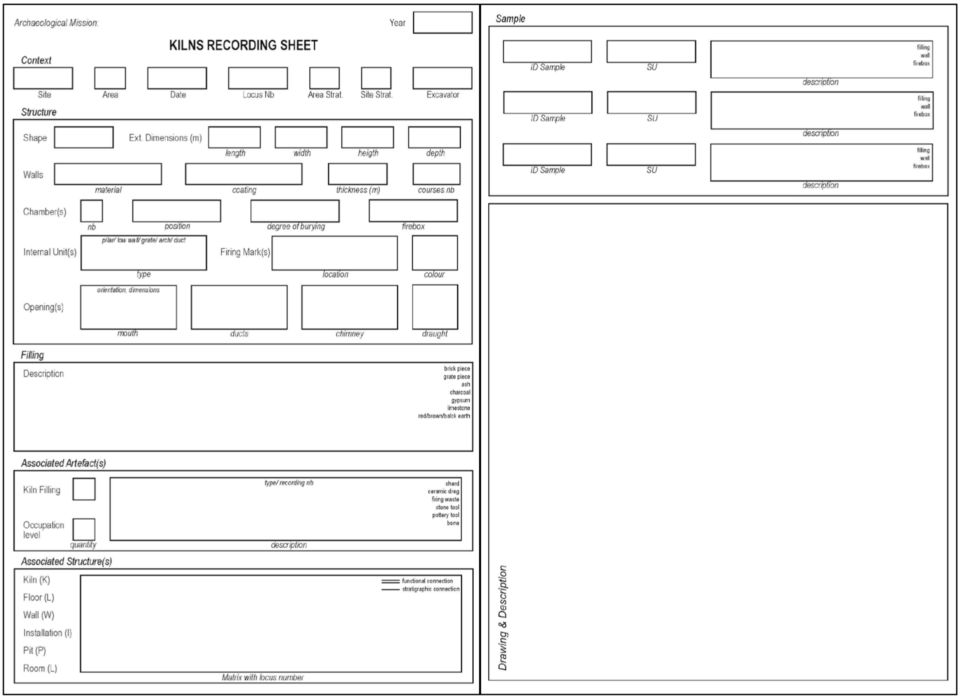

Fig. 3 – Kiln recording sheet.

area, other structures related to pottery production (such as benches and basins), and the materials associated with the area, including tools, waste, and ceramic products. The quantity and the quality of data varied from site to site, depending on the conservation of the remains and the recording method used. Half of the data were scattered across publications spanning from the 1930s to the present, written by archaeologists of different nationalities with diverse scientific backgrounds. The other half consisted of unpublished data, collected by several archaeological campaigns at Aliawa (Italian Expedition in the Erbil Plain) and Logardan (French Archaeological Mission in the Qara Dagh). These latter pieces of data were recorded using a standardised sheet (Fig. 3). It provided a framework to collect data on the field, matching with the database.

To be findable, data underwent formalisation and integration into a structured format (Fig. 4). The structure of data sets is as important as the value of the data, as it facilitates transforming data into information. It uses simple language and avoid ambiguity and repetition (Gonzalez-Perez 2018). The database presents five tables connected to each other: 'Firing

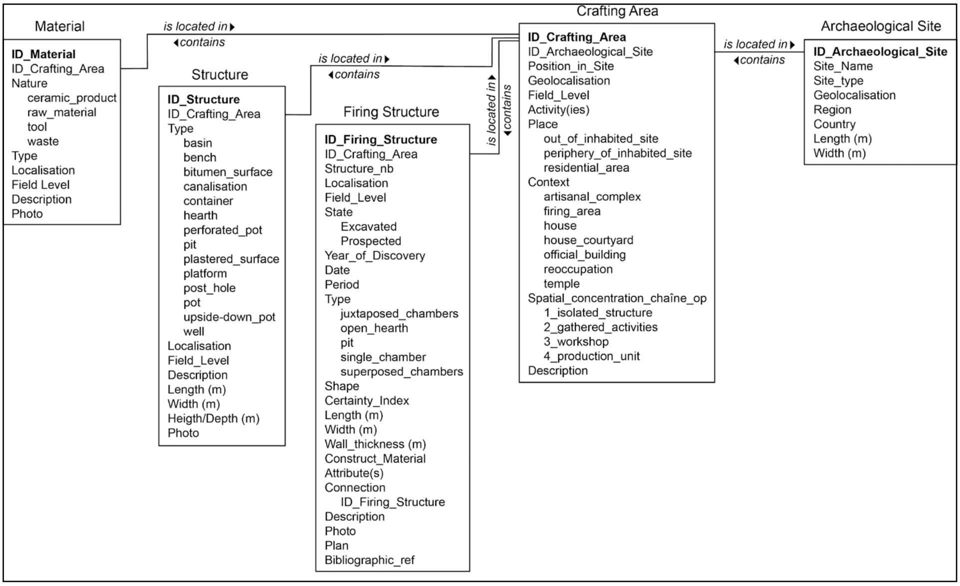

Fig. 4 – Kiln relational database structure.

Structure', 'Material', and 'Structure' are connected to 'Crafting Area' and the latter is connected to 'Archaeological Site'. This structure underlines the spatial connections of the various archaeological elements related to pottery workshop within a site: for instance, the number of crafting areas (i.e. a continuous space dedicated to pottery production) within a site, or the number of kilns within a crafting area. In the firing structure table, type and shape are differentiated, as highlighted above (cf. §3).

4.2 *Accessibility and ethics*

The database was implemented on Heurist (https://heuristnetwork.org/), an open-source software developed specifically for researchers in the Humanities and designed for managing relational databases. Its use is growing in CNRS laboratories and humanities departments in France. Both the software and the database are hosted on the research infrastructure managed by French CNRS Huma-Num platform (https://heurist.huma-num.fr), which handles maintenance and ensures durability. All data are stored directly on the server, offering the advantage of automatic data backup but also the risk of inoperability in case of restricted access to Internet.

In addition, Heurist is fitted both for research and diffusion, a combination that is not straightforward to achieve. First, the accessibility of

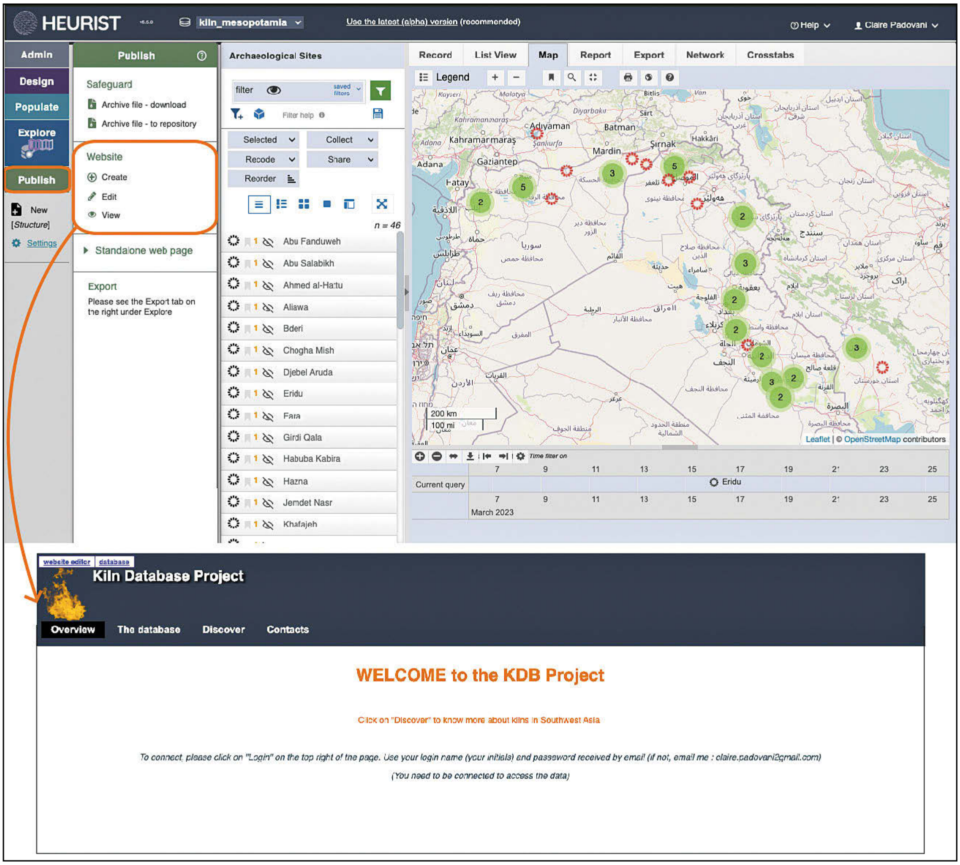

Fig. 5 – The database and website interfaces.

the database management interface is password-protected, allowing control over who can access and modify the data, with the capability for multiple individuals to work at the same time on the database. The restriction of data modification aims not only to preserve data integrity but also to encourage direct contact between scholars who wish to contribute to the database. Facilitating personal interaction between researchers working on a same subject but on different periods and regions, rather than relying on system-based exchanges, is key to limiting horizontal biases in knowledge construction and enhancing research collaboration. The interface is user-friendly, using SQL that provides the possibility to add extensive metadata, facilitating the standardisation of vocabulary and its use by scholars working on different regions and periods, generally using different terminologies. Therefore, it is

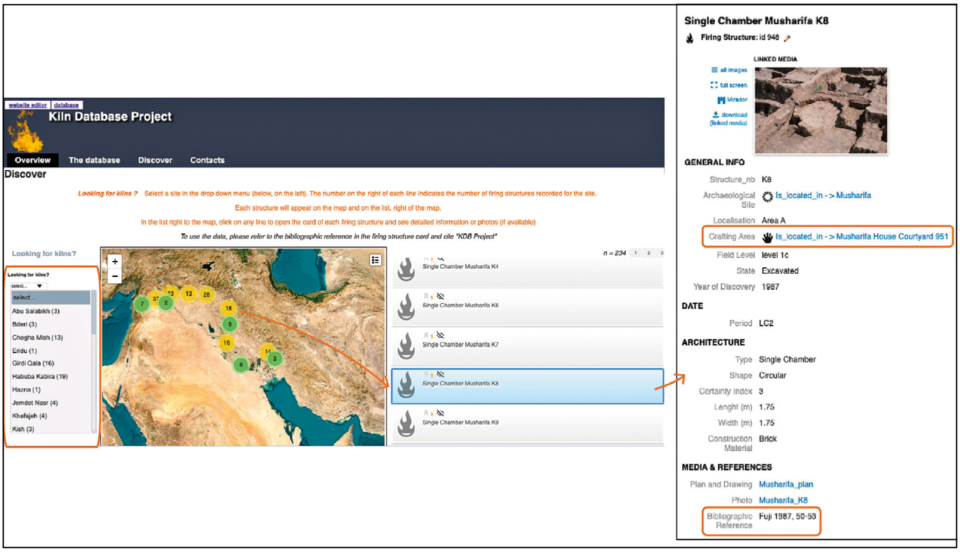

Fig. 6 – The 'Discover' page.

possible to make queries or searches for combining the data and generating information.

Second, the interface proposes a Content Management System (CMS) that allows for the creation and management of a website directly from the database interface (Fig. 5). For now, the website is accessible only upon identification, as its design still requires improvement and optimisation for mobile devices before public release. To ensure appropriate attribution in subsequent scientific research, users are requested to cite both the original bibliographic reference from which the data are derived and the KDB project interface. As part of the ongoing redesign of the public interface (cf. §4.4), persistent identifiers will be assigned to datasets to ensure consistent referencing.

Acknowledging the potential for users to be discouraged by an abundance of complex data, the interconnected table structure of the database is advantageous for a gradual access to information, based on the needs of each individual. On the 'discover' page of the website, users can access a clickable map or a pre-constructed query ('kilns per site') (Fig. 6). Moreover, it is possible to incorporate a search bar for launching searches based on keywords. Both the map and the preconstructed query give access to a list. Each line is connected to a firing structure descriptive card with images and data related to the selected element. Images are crucial for quickly

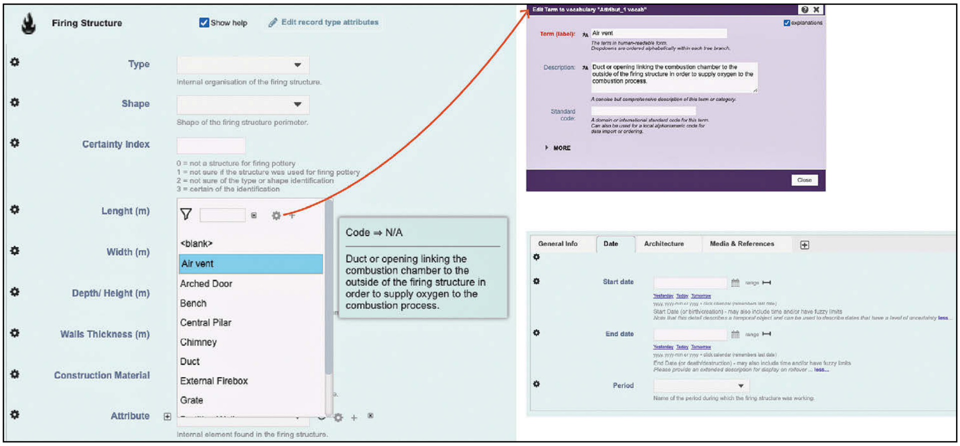

Fig. 7 – Field's metadata in firing structure table.

identifying the desired information (for example, a comparative specimen to a structure found on the field). Then, to verify or delve deeper into the information regarding each firing structure and its context, users can explore architectural details, related crafting area, and bibliographic references. The crafting area link gives access to the other archaeological remains found in the same area (tools, other structures or pottery material).

4.3 *Interoperability and authority to control*

One of the forthcoming objectives of the KDB project is to extend the database to new periods and new regions and eventually to allow other users to record data. Therefore, to anticipate, each field identifier is carefully explained in a few words (Fig. 7). The Heurist software is inherently cooperative and interoperable as it allows to use the field identifier created by other users. For instance, the KDB uses the 'start date' and 'end date' fields available on the interface. The field names and descriptions used in each project can be modified at any point without losing the data. This metadata ensures that others can exploit and add new data, although the database structure mirrors a personal research and interpretation of kilns and crafting areas. Kiln experts employ different vocabularies depending on the period and region they are working on. Therefore, thanks to a grant from the Advancing fronTier Research In the arts and hUManities Project (ATRIUM), a thesaurus will be developed to ascertain universally accepted definitions and equivalence between the terms employed.

Furthermore, the firing structure table is not organised into heat circulation, heat transfer and heat production components, following the method of firing structure analysis applied in the study of this specific corpus. Instead, the firing structure is deconstructed into descriptive fields which are universally comprehensible (shape, presence/absence of attributes, etc.). This facilitates the reuse of data according to alternative methodology and for other needs that typological classification. The documentation of bibliographic references is included in the 'Firing Structure' table to provide transparency about the sources of published data. In addition, various types of data (films, sounds, photos, texts, coordinates, etc.) can be imported in multiple formats (including the CSV format used in spreadsheets) and exported easily in XML to be reloaded on any up-to-date MySQL database server.

4.4 *Reusability, responsibility and collective benefit*

The database must be flexible enough to provide immediate solutions and accommodate potential future developments that may not be currently anticipated. On Heurist, the database structure can be smoothly modified at any point. This adaptability is a notable advantage as data recording requirements often evolve throughout the research process or the database use. Furthermore, to engage the user and provide value, the website should be as visually appealing as an 'Instagram for kilns'. Given that digital users are accustomed to user-friendly interfaces, collaboration with a developer is essential to improve the database design. Finally, while ensuring a large quantity of accessible data is crucial, equally significant is the sharing of the tools to generate and improve information and knowledge on a single platform. The database website will include blog papers to detail the method behind the database structure, along with general information and references about kilns and pottery production spaces. In addition, a 'certainty index', ranging from 0 to 3 was introduced, to qualify interpretation of each firing structure type (Figs. 6-7):

– 0, null. The structure does not serve pottery-making purposes but fulfills another pyrotechnological function;
– 1, uncertain. Highly eroded remains, surface spotted, poorly documented. It cannot be confirmed whether the structure is used for firing pottery;
– 2, probable. Poorly preserved or documented remains, its artisanal function is confirmed, but uncertainty persists about the design or the shape; it may be interpreted through analogy with similar structures;
– 3, certain. Well-preserved, well-documented remains. The interpretations of the design and the shape are reliable.

Following the proposed methodology, the categorisation of firing structure is contingent upon the relative positioning of the heat production, heat circulation and heat transfer components. However, since firing structures are rarely preserved in their entirety, their classification necessitates interpretation. The use of a certainty index enables stakeholders, including a future self, to reuse data about firing structures, while acknowledging the potential risk of misinterpretation. The weakest interpretations can be easily spotted to be improved if new data are available. Furthermore, the database aims to facilitate the reassessment of data with diverse approaches. Data reusability fosters the standardization of descriptions, identifiers, and methods. However, it also tends to promote one dominant approach, perceived as superior, thereby constraining the emergence of new methods and interpretations.

5. Conclusion

This paper explores the theoretical and methodological challenges in constructing knowledge about ancient pyrotechnology in Southwest Asia, emphasizing how historical biases and fragmented data have hindered the understanding of firing structures. By adopting a system-thinking approach, the KilnDataBase (KDB) project offers a structured framework that addresses both vertical (interpretative) and horizontal (diffusion) processes of knowledge construction. As both are linked, the ambition to diffuse information emerged concurrently with data collection and analysis, and orientated the selection of the Heurist software. Through the development of an open-access database aligned with the FAIR and CARE principles, the project seeks to improve data accessibility, promote equitable knowledge sharing, and facilitate the identification and study of firing structures. Ultimately, the KDB initiative demonstrates how the systematic and structured availability of valuable archaeological data, has great potential to support new research and knowledge generation.

The work is ongoing, and although full alignment with the FAIR and CARE principles has not yet been achieved, they provide essential guidance in the transformation of the database into a sustainable and accessible repository. The forthcoming development of the KDB project involves the creation and implementation of a thesaurus, establishing standardized vocabularies and equivalences among the diverse terminologies currently in use, in collaboration with experts in pyrotechnology from various regions and chronological contexts. The Pottery Pyrotechnology and Craft Spaces OPen Vocabulary (PPOP Voc) will be undertaken in partnership with the Austrian Center for Digital Humanities & Cultural Heritage (ACDH-CH) in Vienna). The lack of a shared and standardized vocabulary has long impeded effective knowledge exchange and methodological coherence within the archaeological community. This terminological fragmentation complicates not only the identification and interpretation of pyrotechnological structures in the field but also hinders datamining, interoperability, and cross-regional collaboration among researchers addressing similar questions. The collaboratively developed vocabulary will be integrated into the KilnDataBase (KDB), thereby improving semantic interoperability and facilitating broader comparative and integrative research.

Claire Padovani
UMR 5133 Archéorient
clairepadovani2@gmail.com

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ABSTRACT

In actual archaeological projects, there is a push towards embracing open science principles, which involves the transparent sharing of raw data and research protocols to facilitate knowledge dissemination. This emulation fosters technical innovation in the field of software development applied to archaeology, to diffuse large amount of data. However, implementing open science effectively poses significant theoretical challenges to consider when selecting a technical solution. This paper investigates the historiography of pottery kiln research - a field that remains relatively underdocumented - to identify inherent biases in the construction of knowledge, in order to guide the creation of a sustainable and widely accessible body of knowledge on the subject. It details the systemic conceptual framework, decision-making process, and technical implementation of an open-access database designed to record data on pyrotechnology and related archaeological contexts, thereby facilitating comparative analysis

and identification of firing structures on the field. Although the database is currently in an early stage of development, it is essential to critically assess theoretical and methodological project requirements, consider how data structuring shape knowledge, and ensure that the chosen software infrastructure aligns with the FAIR and CARE principles, to achieve in the near future, the creation of a robust and enduring data repository.