

Article

Digital Guardianship: Innovative Strategies in Preserving Armenian's Epigraphic Legacy

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Abstract: In the face of geopolitical threats in Artsakh, the preservation of Armenia's epigraphic heritage has become a mission of both historical and cultural urgency. This project delves deep into Armenian inscriptions, employing advanced digital tools and strategies like the Oxygen text editor and EpiDoc guidelines to efficiently catalogue, analyze, and present these historical treasures. Amidst the adversities posed by Azerbaijan's stance towards Armenian heritage in Artsakh, the digital documentation and preservation of these inscriptions have become a beacon of cultural resilience. The XML-based database ensures consistent data, promoting scholarly research and broadening accessibility. Integrating the Grabar Armenian dictionary addressed linguistic challenges, enhancing data accuracy. This initiative goes beyond merely preserving stone and text; it is a testament to the stories, hopes, and enduring spirit of the Armenian people in the face of external threats. Through a harmonious blend of technology and traditional knowledge, the project stands as a vanguard in the fight to ensure that Armenia's rich epigraphic legacy, and the narratives they enshrine remain undiminished for future generations.

Keywords: digital epigraphy; cultural heritage; digital collection; lemmatization; EpiDoc



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1. Introduction

There is a famous saying that Armenia is an open-air museum. This saying has proof: there are cultural monuments—cave-cities, churches, chapels and monasteries, khachkars* and vishapakars—spread all over the territory of the Armenian Highlands, as evidence of over five millennia of uninterrupted Armenian presence and its developing culture from cuneiforms to alphabetical inscriptions appearing on buildings and monuments starting with the invention of the Armenian alphabet in the fifth century AD. Ancient and medieval Armenian architecture is also a repository of miniature, paintings, and inscriptions, as well as Hellenistic, Byzantine, and medieval Western European cultures. Being an arena of invasions and earthquakes, Armenia lost much of its cultural evidence over the centuries to recover and rebuild and leave written records of the events. However, that damage cannot be compared with the targeted erasure of Armenian cultural heritage in the 20th and 21st centuries, accompanied by the violent depopulation of cities and villages based on territorial claims of former Soviet Azerbaijan.

Artsakh or the Russian-called Nagorno-Karabakh region is the easternmost part of the Armenian Highlands, and, like the rest of historical Armenia, abundantly bears the traces of its original cultural content, and especially monasteries, schools, churches, and fortresses built in the past two millennia¹. After it was annexed by Stalinists to Soviet Azerbaijan in 1919, acquiring the status of an autonomous republic, the Armenian population of the region was under constant economic discrimination, oppression, and killing². In 1991, after the announcement of independence by the former Soviet Republics, the referendum of the Artsakh Armenian people announced their will for freedom and independence, fought for

it, and established a new state, with all its attributes and infrastructures: there were schools and universities, museums, and businesses. It existed for almost 30 years, until in 2020, replicating Russian expansive intentions, Azerbaijan unleashed a new war against this ethnic minority in the once-Soviet Azerbaijanian Republic. These days, when we are writing this article, the process of ethnic cleansing of Armenians from their homeland is advancing at its full pelt. It was clear still in 2020 that the cultural heritage in the Nagorno-Karabakh region appeared to be under an imminent threat³.

Over recent decades and years, this disputed territory in the South Caucasus, recently recognized as part of Azerbaijan while originally inhabited by ethnic Armenians for over a millennium, has experienced the irreversible destruction of its Armenian heritage, orchestrated by Azerbaijan authorities [1]. The European Parliament's resolution on destroying cultural heritage in Artsakh highlights the dire impact of the prolonged conflict between Azerbaijani forces and local Armenians on the region's cultural landscape and historical sites⁴. The deliberate efforts to erase Armenian cultural heritage, preceded by the well-known demolition of Armenian khachkars in Nakhijevan (etymologically proven Armenian toponym meaning "a place before lodging") encompass causing damage or demolishing Armenian cultural artifacts now in Artsakh and distorting historical evidence by presenting the area as Caucasian-Albanian, a coined term deprived of factual evidence. This is documented through the formation of a working group by the Azerbaijani Minister of Culture on 3 February 2022, whose "mission" is dedicated to erasing the Armenian cultural footprint from the territory⁵. In the face of a dire humanitarian crisis in Artsakh, the 9-month blockade and aggression of September 2023, where Armenian inhabitants were compelled to flee their homeland due to intense military actions initiated by Azerbaijani forces, preserving both national identity and cultural heritage becomes an imperative mission. The ongoing conflict unleashed a barrage of missiles and weaponry in the fall of 2020, leaving the Armenian population without any guarantee of security and compelling them to seek refuge elsewhere. To crown this all, Azerbaijanian authorities have prohibited the refugees from evacuating museums or other portable cultural values⁶.

2. Research Objectives

As part of the rescue actions coordinated by the *École Polytechnique Fédérale de Lausanne*, the Digital Humanities Institute, within the "Digitization of the endangered Armenian Epigraphic cultural heritage in Nagorno-Karabakh region" project frameworks, is prototyping methods for rapidly deploying Digital Humanities technology in crises created by the restricted access to the region and depopulation policies [2]. This project aims first to digitize the Armenian epigraphic heritage in Artsakh as fast as possible, develop relevant tools for that purpose, and later leverage the developed guidelines and methods to the inscriptions in Ukraine, which have not been properly digitized. Ukrainian academics actively engage in numerous research and preservation projects to protect the country's cultural heritage despite these challenges⁷ [3]. This commitment reflects a strong collective effort to safeguard these valuable historical assets under difficult circumstances.

In this turbulent context, the Armenian epigraphic heritage assumes a paramount role. Spanning from the 4th to the 21st centuries, these Christian inscriptions in stone are not mere historical artifacts; they embody a profound connection to the region's cultural background, language, and culture [4,5]. They stand as tangible evidence of the enduring Armenian presence in Artsakh, a testament to the roots of the Armenian community in this territory, and a cornerstone of their collective identity [6,7]. Here in Amaras monastery, the first Armenian language school was founded by Mesrop Mashtots, the linguist who invented the Armenian alphabet in AD405. Now, the inscriptions of Amaras are an invaluable testament to the earliest stage of European civilization in its easternmost corner.

These epigraphic inscriptions serve multifaceted functions, encompassing religious, commemorative, funerary, and legal purposes. They are windows into the beliefs, traditions, and historical events that have shaped the lives of those who have inhabited this region for

centuries. The significance of these inscriptions extends far beyond their stone surfaces; they represent the living memory of the people bound to this land.

As the conflict continues to displace Armenian inhabitants and threaten the cultural and historical fabric of Artsakh, preserving these inscriptions becomes not only an academic endeavor but a moral imperative. They are a testament to resilience, endurance, and the ownership of a people who refuse atrocities and human degradation. In the face of adversity, these inscriptions speak volumes, and their protection is an act of safeguarding a most informative part of the world's cultural heritage. As mentioned above, responding to the peril of losing this invaluable heritage, the EPFL has initiated the project for digitizing the endangered Armenian inscriptions in Artsakh⁸. This initiative has garnered support from the Swiss National Science Foundation's program. Disturbingly, the deliberate erasure of Armenian cultural heritage in Artsakh involves not only physical damage and elimination⁹ but also the falsification of history, aiming to present it as "Caucasian Albanian" [8]. Artsakh's Armenian epigraphic heritage is of great historical, cultural, and scholarly importance. The destruction of this heritage would result in the loss of significant values of cultural diversity.

- Armenian epigraphic inscriptions offer invaluable historical documentation that illuminates the region's history as part of world and European civilization. The ancient inscriptions provide unique information about the past social, religious, and political aspects of the communities and social and political structures that inhabited the area. The loss of this heritage means the loss of a significant repository of world history, the loss of people's right to their original homeland, and the loss of knowledge about human evolution and the achievements of civilization.
- These inscriptions are an integral part of Armenian culture and identity. They are not solely stone carvings, but they also serve as a means of artistic self-expression, creativity, and language for the Armenian community. They facilitate comprehension and conservation of Armenian heritage, establishing a connection between contemporary Armenians and their forefathers and cultural origins. Beyond this, they are the evidence of the flourishing civilization of the larger Middle Eastern region.
- The eradication of inscriptions would significantly impede epigraphic and linguistic studies and distort the big picture of the world epigraphic landscape. The inscriptions offer valuable material for studying the Armenian language, dialects, scripts, and overall, the evolution of language and thought. Academics utilize inscriptions to enhance their comprehension of ancient languages, communication, and information studies, and to decode and construe historical texts.
- Epigraphic inscriptions are often discovered in archaeological contexts, including churches, monasteries, cemeteries, and other historic locations. These sites hold significant cultural information, and the removal of the inscriptions would result in the loss of their original context. This loss impedes the possibility of reconstructing the historical and cultural terrain not only of Artsakh but of the entire region, observing macro-cultural trends and the evolution of human civilization.
- The loss of Armenian epigraphic heritage would impact not only Armenia but also the global community in the realm of International Cultural Heritage. The object in question is a significant component of our collective global legacy, exemplifying a distinctive period in the human chronicles. The destruction of cultural artifacts, wherever they are, is unacceptable and is characterized as a crime against humanity, cultural diversity, and human collective intelligence.

Armenian inscriptions have long been invaluable resources across various academic disciplines within Armenian Studies. However, integrating the study of Armenian inscriptions, the emerging Digital Epigraphy resources and methodologies have so far been a relatively unexplored terrain [9–12]. This project marks a significant stride towards addressing this gap, shedding light on methodological intricacies unique to the application of information technologies in Armenian epigraphy. The incorporation of computational

approaches holds the promise of revolutionizing the study of Armenian epigraphy, paving the way for fresh and uncharted inquiries into this rich heritage.

3. Methodology

Compiling and structuring data for this project involves several sequential stages, starting with collecting raw materials in the form of photographic and textual data. Photographic data encompasses images and visual records pertinent to the project. The textual data include transcriptions, translations, bibliography, historical background, and other relevant information that provide a narrative and interpretive context for the photographs.

Once gathered, these two data types are brought together using DHAnnoto¹⁰, a software tool developed by the researchers of the EPFL to automatically extract all the graphical information from the historical land registers. Following the initial compilation, the merged data are then processed using the Oxygen Text Editor, which is guided by EpiDoc guidelines, a standard for editing and publishing ancient documents (Figure 1).

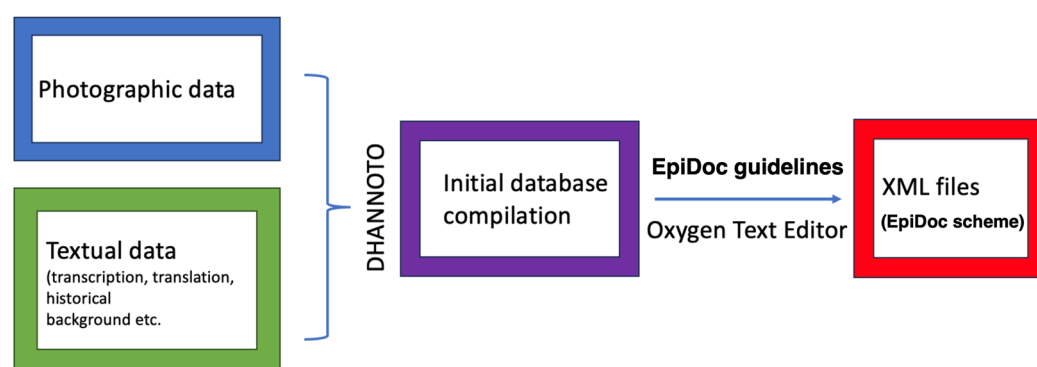


Figure 1. Data Compilation Workflow for Armenian Digital Epigraphic Database.

3.1. Photographic Data Collection

Accessing the territory claimed and now recognized as Azerbaijan has been managed through a passage controlled by Russian troops. It posed a significant challenge for non-Azerbaijani citizens to collect data. These days, when we are writing this article, Artsakh, all its towns and villages, is being completely cleansed of its 120,000 Armenian population, turning the hurdle into a total ban of access to the people's homes and heritage. Under the explicit threat of shelling, arrests, and kidnapping, the established volunteer and local partnership networks have ceased operating, leaving us with the photos and data collected up to the last decade of September 2023, when the ethnic cleansing operation began with bombarding the peaceful population.

Within the framework of the "Digitization of the Inscriptions on the Monuments of Armenian Cultural Heritage in the Nagorno-Karabakh Region" project, we created a network of collaborators in Armenia and Artsakh. Key contributors to this network include the State Service for the Protection of the Historical Environment of the Republic of Artsakh*, the representatives of the Armenian Apostolic Church in the Republic of Artsakh, and Brusov State University of Yerevan, Armenia.

Establishing a robust network of partners and volunteers proved to be instrumental in overcoming the formidable challenges posed by restricted access to the region. The State Service for the Protection of the Historical Environment of the Republic of Artsakh stood out among our primary collaborators. This organization is responsible for preserving, studying, promoting, and utilizing the state's historical, archaeological, and architectural monuments, along with safeguarding the historical and natural environment. Notably, this organization had previously held significant influence as a regional policymaker. Our collaboration with them, namely with the head of this organization, Armine Hayrapetyan, and the representatives of the Armenian Apostolic Church located in the Republic of Artsakh, granted us access to invaluable photographic archives of inscriptions (Figure 2).

This access significantly enriched our database, allowing us to include high-quality visual documentation of inscriptions from various monuments. Moreover, the expertise provided by our partners played a pivotal role in enhancing the comprehensiveness and accuracy of our database. Expert consultations regarding the historical context of monuments and the interpretation of inscriptions ensured that our data were well-documented and effectively contextualized within the broader historical and cultural landscape.



Figure 2. Dadivank monastery Katoghike Surb Nshan Church, 1214, the southern facade.

At the English Translation department of Brusov State University, we undertook the Armenian epigraphic terminology translation, thus making it possible to integrate the Armenian cultural heritage into the world epigraphic database and contribute to it both with data and new scientific concepts.

Furthermore, our efforts were reinforced by the active involvement of several members of the local Armenian community, in total blockade for nine months by Azerbaijan. They worked under extremely dangerous conditions to document and transfer the photos and data, unfortunately only a part of the rich cultural heritage of the Nagorno-Karabakh region. This fostered a sense of community engagement and empowerment, bringing local epigraphic material into the public consciousness and rendering it comprehensible as “voices of stone” from the community’s past.

3.2. Digitization Toolkits

The following decision to be made was the software choice. For the initial database compilation, we decided to use the software DHAnnoto, even though it is not designed for digital epigraphy. However, it turned out to be very useful for our project thanks to its ability to seamlessly merge photographic and textual information, thereby creating an organized and unified initial database. This tool uses WikiData tagging systems to automatically extract information and link it to appropriate WikiData tags as an alternative information reference. With this tool’s search functions, targeted queries for specific words in inscription texts in English or Armenian and specific metadata can be carried out. The

search results are presented with photos or drawings, the diplomatic and interpretive transcription of the inscriptions and the metadata in Armenian and English.

During the next stage of compiling a comprehensive database of Armenian inscriptions, we harnessed the formidable capabilities of the Oxygen text editor¹¹ software to work according to EpiDoc standards [13]. This particular software was a strategic choice driven by its adaptability and remarkable support for XML-based encoding. Oxygen text editor, renowned for its versatility, unveiled many features that significantly expedited our undertaking. Its flexibility allows us to seamlessly adapt it to our specific requirements while effectively managing the intricacies of Armenian inscriptions. This adaptability is particularly crucial given the diverse nature of inscriptions, ranging from varying historical periods to distinct linguistic characteristics.

One of the hallmark attributes of the Oxygen text editor that has made it indispensable to our project is its robust support for XML-based encoding. This support is pivotal in enabling us to adhere to the EpiDoc schema, the designated framework for our database. XML, recognized for its structured and hierarchical format, is a satisfactory conduit for organizing the multifaceted data intrinsic to Armenian inscriptions. With Oxygen's comprehensive XML-handling capabilities, we can encode, store, and manage almost all of the diverse information embedded within each inscription.

As mentioned above, our approach to implementing the database of Armenian inscriptions relied fundamentally on the well-established EpiDoc guidelines [11,13]. This comprehensive framework is tailored explicitly for ancient inscriptions and their associated texts, offering an XML-based markup standard that is the backbone of our methodology. The adoption of EpiDoc was a strategic choice driven by its ability to provide a robust and structured framework for the effective organization and presentation of data related to Armenian inscriptions.

3.3. Procedure

While our initial decisions regarding software, standards, and data sources were well-founded, the data collection, categorization, and digitization process has not been without its share of challenges.

3.3.1. Challenge 1: Adapting EpiDoc for Armenian Inscriptions

While the EpiDoc schema has proven invaluable in accurately encoding Armenian inscriptions' linguistic, paleographic, and contextual information, allowing us to unlock their historical, cultural, and linguistic significance for future generations, some adaptations are necessary for Armenian inscriptions due to their unique alphabet and punctuation norms, unique symbols, and abbreviations.

As an illustration, a significant challenge emerged in deviations from Greco-Roman writing traditions, specifically related to punctuation within Armenian inscriptions. One notable example of this deviation is the unique use of two vertical dots (:) in Armenian inscriptions. These dots serve not only as the punctuation mark for a full stop but also as markers for indicating dates, personal names, and honorary attributes. This departure from the conventions of other ancient languages posed a distinct challenge in accurately representing the inscriptions within the EpiDoc schema (Figure 3).

```
<lb n="1"/><w>ԵՄ ԴԱ ԳԻՏԵՄ :></w><!-- : functions as a punctuation mark -->
<lb n="1"/><w>ԵՄ ԴԱ ԳԻՏԵՄ :ԹԺ:></w><!-- : separates the letters that indicate numerals -->
```

Figure 3. Fragment used to illustrate our concept. Screenshot of the extract of the xml file.

To address this challenge, we are actively pursuing two viable solutions. First, we are considering the development of a separate XML file within our database, specifically designed as an internal reference. This file will encompass a comprehensive list of symbols, punctuation marks, and abbreviations typical of the Armenian script. The aim is to

incorporate this reference to ensure that our transcriptions accurately capture the unique punctuation style of Armenian inscriptions.

Second, we are exploring the possibility of leveraging the guidelines provided within the EpiDoc framework for symbols and punctuation¹². EpiDoc offers specific guidelines for encoding various symbols, and we are carefully assessing these guidelines to determine their compatibility with Armenian inscriptions. This approach would align with the established standards of EpiDoc while effectively accommodating the distinct features of Armenian inscriptions.

3.3.2. Challenge 2: Lemmatization Process

The Armenian language boasts a rich and intricate grammatical system, which can present challenges in standardization efforts. An illustration of this can serve the Armenian nouns, which can have five to seven inflections depending on the scholar and the theory [14]. These inflections can manifest as specific ending changes in cases of external inflection or even as root alterations in situations of internal inflection. We cite the complexities inherent in the noun system without delving into the verb system or other grammatical components. Such complexities amplify the need for a methodical approach like lemmatization in our database. By reducing words to their most basic form, termed the lemma, we aim to eliminate inconsistencies introduced by these inflections, conjugations, and declensions. This ensures a uniform and standardized representation of language in the database. Furthermore, our approach is tailored to enhance search and retrieval functionalities, allowing users to search for a lemma and retrieve all its variations seamlessly.

Lemmatization Tools and Resources

To navigate the complexities of the Armenian language and ensure the precision of our lemmatization process, we turned to the Grabar Armenian dictionary. Accessible online at <http://www.hyspell.com/grabaran> (accessed on 13 March 2020), this lexicon offers comprehensive insights into the lexicon and linguistic intricacies of the ancient Armenian language, Grabar [15]. It proved indispensable, especially when dealing with entries spanning diverse grammatical categories including, but not limited to, nouns, verbs, adjectives, and their nuanced inflections (Figure 4).

```

<lb n="1"/><w lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^Ես">Ես</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ԵՍ">ԵՍ</w><supplied reason="lost">ի</supplied>քայլ</w>
<w lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^որ">որ</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^միշտ">միշտ</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ՊԱՀԵԼ">պահեմ</w>
<lb n="2"/><w lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ԴՈՒ">զբեզ</w> <w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ել">ել</hi></w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^զործակից">զործակից</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ԵՍ">ԵՍ</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ԴՈՒ">քեզ</w>
<lb n="3"/><w lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ի">ի</w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ՄԱՆԿՈՒԹԻՒՆ">մանկութ<hi rend="supraline">եմ</hi></w><w
lemmaRef="http://www.hyspell.com/grabaran/Home/Index/^ի">ի</w><expan><abbr><hi rend="supraline">քլ</hi></abbr>
<ex>իլ</ex></expan><g>high-punctus</g><date><num value="1297"><hi rend="supraline"></hi><g type="high-
punctus"/>ՉԻՁ<g type="high-punctus"/></num></date>

```

Figure 4. Fragment of the fresco inscription from Katoghike Sourb Nshan Church located in Dadivank Monastery [16], Dadivank Village, Shahumyan District, Republic of Artsakh. Screenshot of the extract of the xml file.

3.3.3. Challenge 3: Standardized Armenian Vocabulary

An extensive challenge we encountered in our mission was the creation of a specialized Armenian vocabulary tailored to digital epigraphy. This vocabulary needed to encompass a wide range of facets related to inscriptions, including object types, monument types, inscription types, materials, preservation states, letter types, decoration, symbols, and execution techniques. To address this challenge, our project is diligently compiling term lists, which are subsequently being transformed into XML files, with terms presented

in both Armenian and English (Figure 5). When an English term aligns with a term in the EAGLE vocabulary¹³, a reference is directly embedded by the <ref> attribute. These files serve as invaluable internal references, enhancing data categorization within the digital domain.

```
<support>
  <objectType xml:lang="eng">fresco</objectType>
  <objectType xml:lang="arm">որմնանկար</objectType>
  <material xml:lang="eng">plaster</material>
  <material xml:lang="arm">սվաղ</material>
  <dimensions></dimensions>, etc.)
</support>
```

Figure 5. Screenshot of the extract from our “material_type.xml” file showcasing the structured data representation.

However, a significant hurdle looms large: identifying and clarifying Armenian terms. The presence of ambiguities in Armenian terms, as used by different authors, underscored the critical necessity for clear and precise definitions. Achieving uniformity and accuracy within the glossary became paramount.

Preliminary findings have revealed the absence of a harmonized and unified system of terms scholars employ to describe, for instance, the script types used in Armenian inscriptions. Furthermore, these terms exhibit variations in their translation into English. Consequently, standardizing Armenian terms and providing explicit definitions for the concepts they represent becomes an imperative undertaking. It is worth noting that in Armenian academic literature dedicated to epigraphy, different authors often assign distinct meanings to the same terms. For instance, “Kapgir”, [Eng. Link_gram] “Ktsagir”, [Eng. Attach-gram], and “Pakgir” [Lock-gram] refer to various types of ligatures but are used differently in diverse contexts. Moreover, “Pakgir” corresponds to the concept labeled as a “monogram”, yet within Armenian academic literature, it is typically represented as a ligature, or at least a form thereof [5,17] (Figure 6).

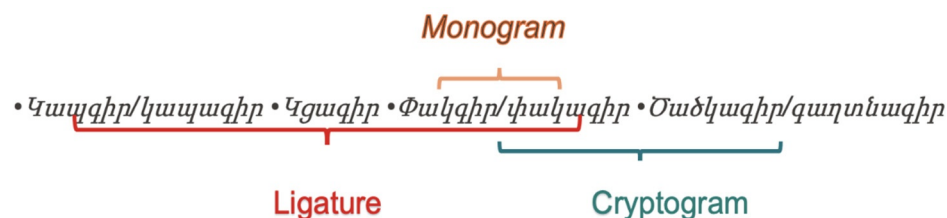


Figure 6. Overlapping English translations of Armenian terms.

We established a collaborative partnership with Yerevan Brusov State University of Languages and Social Sciences to tackle this challenge effectively. Our project aims to compile a comprehensive list of terms commonly used in Armenian academia to describe inscriptions, complete with explicit definitions for each term. To achieve this, we have been studying the principal published collections of Armenian inscriptions, articles, and relevant publications.

In addition to this scholarly pursuit, we have employed corpus linguistics alignment tools to scrutinize the terms used by prominent scholar Samvel Karapetyan [6–8,18]. His significant contributions to studying and preserving Armenian cultural heritage have made his works particularly relevant. This analysis involves a comparative study of the terms he used in his publications, available in Armenian and English.

3.3.4. Challenge 4: Navigating Access Restrictions and Geopolitical Challenges and Cultural Artifacts

In our pursuit of preserving Armenian inscriptions, we encountered a series of formidable challenges. These ranged from the complex task of editing the texts of in-

scriptions upon published editions to transcribing newly discovered inscriptions and securing high-quality photographic documentation. Moreover, the unique geopolitical situation in the region presented an additional layer of complexity. Access to the inscriptions, situated within a territory recognized as Azerbaijan and controlled by Russian troops, was severely restricted, particularly for foreign citizens.

To overcome these significant hurdles, our project adopted an innovative approach, as mentioned above. We established a network of local partners and dedicated volunteers within the region. This network played a pivotal role in overcoming many challenges. However, an unforeseen setback occurred on 21 September 2023, when access to crucial territories for further autopsy and photographic data collection was abruptly restricted. The disruption also extended to our contact with partners, as the Armenian inhabitants of Artsakh faced perilous conditions, including conflict and displacement, while the Republic of Artsakh ceased to exist.

In response to this daunting challenge, our project implemented two key strategies. First, we leveraged Google alerts focusing on Armenian inscriptions and the cultural heritage of Artsakh, aiming to gather information from various sources, including social networks and the World Wide Web. Through these alerts, we could continuously monitor and gather relevant data, including photographic and textual information, despite the challenging circumstances. And second, we are currently developing a comprehensive critical apparatus, after facing the limitations of the EpiDoc schema and the unavailability of additional photographic data¹⁴. Beyond its core function, this apparatus is also designed to encapsulate details of initial publications. This tool serves as a repository for all relevant information that cannot be accommodated by the EpiDoc framework. In our case, it effectively bridged the gap created by the restricted access to photographic data (Figure 7).

```
<div type="apparatus">
  <original_publication> <!-- Information regarding the first publication of the inscription -->
    <title xml:lang="eng">Original Publication Title</title>
    <title xml:lang="arm">Original Publication Title</title>
    <author xml:lang="eng">Author or editor of the publication</author>
    <author xml:lang="arm">Author or editor of the publication</author>
    <date>Date of the publication</date>
    <reference>Specific page or figure, if applicable</reference>
    <link>URL or identifier if applicable</link>
  </original_publication>
  <recenet_resource> <!-- The primary source or references where the recent information was obtained -->
    <title xml:lang="eng">Resource Title or Description</title>
    <title xml:lang="arm">Resource Title or Description</title>
    <link>URL or identifier if applicable</link>
    <date>Date of resource if applicable</date>
  </recenet_resource>
  <context> <!-- Background or broader context regarding the resource or the information it provides-->
    <details xml:lang="eng"></details> <!-- Specific detail or findings -->
    <details xml:lang="arm"></details> <!-- Specific detail or findings -->
  </context>
  <p>external apparatus criticus (if applicable)</p>
</div>
```

Figure 7. It is important to note that the apparatus described herein represents a preliminary draft, subject to further refinement and revision as our work progresses. While this version provides foundational insights, we anticipate further enhancements and expansions in future iterations.

Amid these trying circumstances, one notable achievement stands out. We acquired photographic data on an inscription from the St. Hakobavank (Metsarants) monastery in the Republic of Artsakh, specifically within the Martakert district, Kolatak village¹⁵. This discovery occurred after 21 September 2023, during a mass exodus of the Armenian population from Artsakh. A local Armenian resident displayed remarkable valor by rescuing a fragment of a decorative element along with a segment of a recently discovered inscription¹⁶. We had previously received photographic data for eleven other inscriptions, but this fragment was new to us.

The success of this discovery can be attributed to our meticulous use of Google alerts focused on Armenian inscriptions and the cultural heritage of Artsakh. Within

our XML file, we have documented the inscription, details about the monument, and other relevant information. In the critical apparatus, we have provided comprehensive particulars regarding the current location of the stone fragments. We have identified the individuals responsible for their preservation, noted the specific individuals involved in photographic documentation, recorded the dates on which these photographs were captured, and contextualized the circumstances surrounding this remarkable find and the source of the information (Figure 8).

```

<div type="apparatus">
  <original_publication>
    <title xml:lang="eng">Original Publication Title</title>
    <title xml:lang="arm">Original Publication Title</title>
    <author xml:lang="eng">Author or editor of the publication</author>
    <author xml:lang="arm">Author or editor of the publication</author>
    <date>Date of the publication</date>
    <reference>Specific page or figure, if applicable</reference>
    <link>URL or identifier if applicable</link>
  </original_publication>
  <recent_resource>
    <title xml:lang="eng"> 2 fragments of cross stone from St. Hakobavank</title>
    <title xml:lang="arm"> Սուրբ Հակոբավանքի տարածքից հանեցի 2 խաչքարի կտոր</title>
    <link> https://www.facebook.com/profile.php?id=100027531458842</link>
    <date>24.09.2023</date>
  </recent_resource>
  <context>
    <details xml:lang="eng"> In our database, we previously housed thirteen distinct photos, representing eleven inscriptions from St. Hakobavank. Therefore, the discovery of these additional inscriptions was particularly noteworthy. Upon coming across an article from Mamul.am, we reached out to Harut Sargsyan. Through this contact, it became evident that these fragments of cross-stones had been relocated for safeguarding during the forced relocation of Armenians from Artsakh.
    </details>
    <details xml:lang="arm"> Մեր տվյալների շտեմարանում մենք նախկինում տեղադրեցինք տասներեք տարբեր լուսանկարներ, որոնք ներկայացնում էին տասնմեկ արձանագրություններ Սուրբ Հակոբավանքից: Ուստի հատկապես ուշագրավ էր այս լրացուցիչ արձանագրությունների հայտնաբերումը: Հանդիպելով Mamul.am-ի հոդվածին, դիմեցինք Հարութ Սարգսյանին. Այս շիման միջոցով ակնհայտ դարձավ, որ խաչքարերի այս բեկորները տեղափոխվել են Արցախից հայերի հարկադիր տեղափոխման ժամանակ պահպանելու համար:
    </details>
  </context>
</div>

```

Figure 8. Screenshot of the extract from the xml file dedicated to the St. Hakobavank, Kolatak village, Martakert district, Republic of Artsakh.

4. Results

Our *collaborative approach*, facilitated by a network of dedicated partners and volunteers, led to significant achievements in digitizing and preserving Armenian inscriptions in Artsakh. So far, we have managed to collect about 150 photographs. The combination of photographic documentation, expert consultation, and community engagement has not only enriched our database but also contributed to the broader goal of safeguarding and promoting the cultural heritage of this historically significant region.

In our project, *the implementation of DHAnnoto* yielded transformative results. Not originally designed for digital epigraphy, it proved invaluable for seamlessly merging photographic and textual data, creating an organized, unified database. Its use of WikiData tagging systems for automatic data extraction and linkage enhanced the database's comprehensiveness. A standout feature was aggregating and visualizing all photographs from a single monument in one space, allowing for a holistic view and comparative analysis. With its advanced search functions, DHAnnoto allows users to conduct precise queries for specific terms within English or Armenian inscription texts, as well as for metadata elements. The results are efficiently displayed alongside corresponding images or illustrations, making the information easily accessible and interpretable. Remarkably, DHAnnoto's user-friendly design did not require specialized digital skills or encoding knowledge, broadening its accessibility and facilitating contributions from a diverse group of researchers and volunteers (Figure 9).

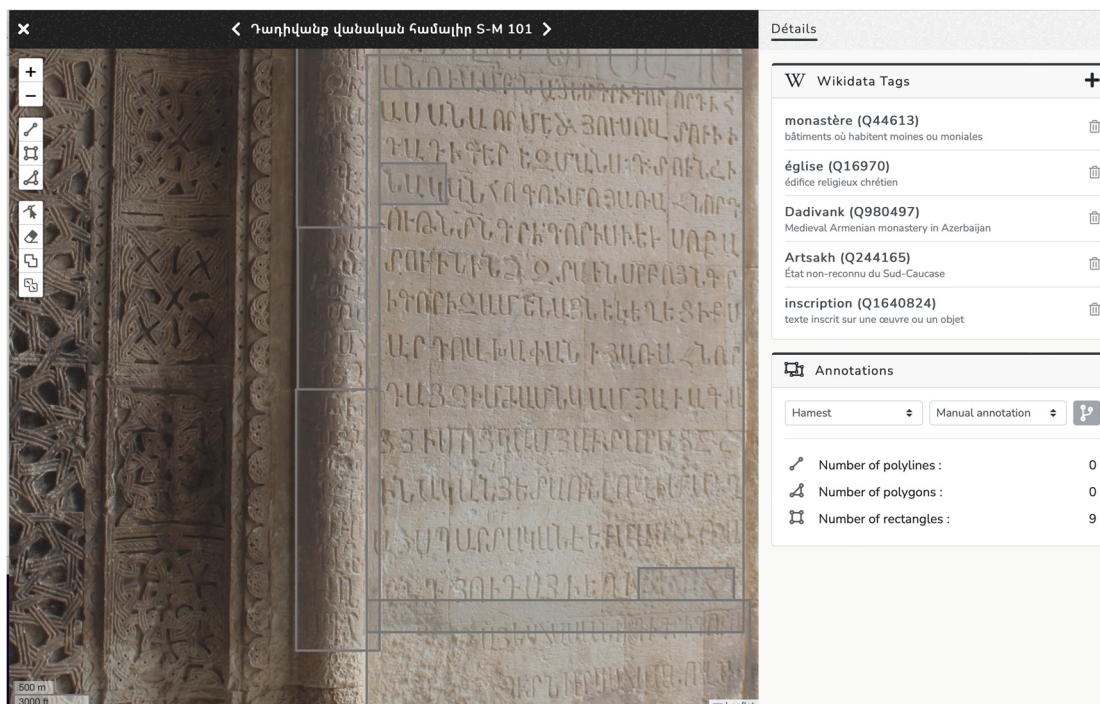


Figure 9. DHAnnoto.

While implementing our database built upon the EpiDoc guidelines, we achieved a range of significant results that have enhanced the organization, accessibility, and scholarly utility of the Armenian Inscription Digital database (AIDD). These outcomes are pivotal to the effective preservation and study of epigraphic heritage.

Implementing the EpiDoc guidelines [13] ensured that our database's content adhered to a standardized and well-structured format. This resulted in data organization making it easier for researchers to access and analyze information about Armenian inscriptions. The consistency in data presentation facilitated cross-referencing and comparison among different inscriptions.

The EpiDoc framework also allows us to capture a comprehensive range of information related to Armenian inscriptions. This encompasses not only the transcriptions and editions of the texts but also their translations, apparatus, commentaries, and bibliographies. Additionally, we can describe the historical aspects, including provenance, location, date, repository, and materiality of the inscribed objects. This holistic approach ensures that researchers have access to a wealth of contextual information.

The next feature to notice is that our database, constructed using EpiDoc standards, is designed with interoperability in mind. The XML-based format ensures compatibility with other digital epigraphy projects and scholarly databases. This interoperability facilitates collaborative research efforts and allows for the exchange of data and insights across different platforms.

Needless to say, using EpiDoc ensures the long-term preservation and accessibility of the database. XML is a stable and widely accepted format, ensuring that the data will remain accessible to future generations of scholars. This aligns with our commitment to preserving and promoting Armenian inscriptions in perpetuity.

The structured nature of the data allows for more in-depth and systematic scholarly analysis. Researchers can easily extract specific types of information, such as all inscriptions from a particular historical period or those with specific linguistic features. This aids in advancing the study of Armenian epigraphy and related fields. The standardized format and metadata incorporated into the database enhance search and retrieval capabilities. Researchers can efficiently locate inscriptions based on various criteria, such as location, historical context, or material properties. This streamlined search process accelerates research

and promotes greater engagement with the inscriptions, including cross-referencing and a broader range of comparative studies. Researchers can easily compare similar inscriptions or trace the evolution of specific linguistic elements across different texts. This capability enriches our understanding of Armenian inscriptions and their historical context.

After implementing our lemmatization methods, the positive impact on our database was immediately discernible in several key areas:

First and foremost, there was a noticeable elevation in the standardization and uniformity across the database. Words were now consistently represented in their most fundamental and standardized form. This was particularly significant given the complexity and richness of the Armenian grammatical system.

Furthermore, the efficiency and effectiveness of our data retrieval processes underwent a remarkable transformation. When searching for a specific lemma, users find themselves equipped to retrieve all associated variations of that word. This applied irrespective of whether the word was in its inflected or conjugated form. This streamlined approach ensured a more user-friendly experience, enabling efficient data retrieval and analysis.

The computational backbone of our database, especially the components related to data analysis, also benefited immensely. We observed a marked improvement in terms of accuracy, speed, and overall efficiency. These enhancements are a testament to the robustness of our chosen methods.

In addition to these improvements, the capability to cross-reference with external resources and databases was substantially expanded. This newfound capability paved the way for more comprehensive and enriched analyses, connecting our database to a larger ecosystem of linguistic resources.

Our strategic decision to integrate the Grabar Armenian dictionary into our methodology proved to be pivotal. The dictionary met our expectations on multiple fronts:

It aligned perfectly with our objectives, catering to the nuances of the archaic forms in our Armenian inscriptions. This precision was essential in ensuring that the lemmatization process was both accurate and relevant.

Additionally, the challenges posed by complex or unconventional morphologies were effectively addressed. The dictionary played a crucial role in providing accurate lemma assignments, ensuring the integrity of our database remained uncompromised.

Lastly, the extensive lexicon coverage offered by the Grabar Armenian dictionary ensured that our lemmatization efforts were comprehensive. There were but few restrictions for us to achieve an optimized and holistic representation of the Armenian inscriptions in our database.

As a result of the strategic initiatives of leveraging Google Alerts focusing on the Armenian cultural heritage of Artsakh and the development of the comprehensive critical apparatus, we can record the following outcomes.

The Google Alert system has provided us with a valuable opportunity to track any data, whether photographic or textual, related to Artsakh's cultural heritage, particularly epigraphy. This system serves as an indispensable tool for staying updated on relevant information and developments in the field. Leveraging the Google Alert system, our critical apparatus integrates all pertinent data related to specific monuments and inscriptions. This includes content that might have been deleted or archived from social media. The apparatus ensures our database remains thorough and accurately documented, even when direct access to certain information is hindered.

This system we have crafted is essential in our mission to safeguard and chronicle Armenian inscriptions. It has enabled us to incorporate unpublished photos and images of moved artifacts, broadening our database. Its precision in recording the present whereabouts of these artifacts and the details of their relocation has been invaluable. An environment lacking an official oversight of these prized items and the hostile stance of the government in charge of the region, which seeks to obliterate such heritage, underscores the significance of our efforts to document and protect these invaluable cultural remnants.

5. Discussion

DHAnnoto has emerged as a pivotal tool in our digital epigraphy project, exemplifying the innovative integration of textual and photographic data. Its pioneering approach in automating and utilizing Wikidata's tagging systems represents a significant advancement in digital epigraphy. This technology not only streamlines the data compilation process but also enhances the accessibility and interpretability of the information. *DHAnnoto*'s user-friendly design is especially beneficial in regions where digital epigraphy is developing, like Armenia and Ukraine, allowing experts to contribute without needing extensive digital training. The tool's ability to blend diverse data types into a cohesive database underscores its role in bridging traditional epigraphy with digital methodologies, catalyzing the evolution of historical record preservation and study.

Our efforts to *adapt the EpiDoc schema* for encoding Armenian inscriptions can have positive outcomes in two key areas: *developing an internal reference* for Armenian symbols, punctuation, and abbreviations and exploring EpiDoc guidelines for symbols and punctuation.

A dedicated XML file within our database, functioning as an internal reference for Armenian symbols, punctuation marks, and abbreviations, can significantly enhance our database, providing a comprehensive list of these unique features commonly found in Armenian inscriptions. As a result, our transcriptions can accurately capture the distinct script and punctuation style used in Armenian inscriptions. This achievement will enhance the precision of Armenian epigraphic material within the digital realm.

Alongside the internal reference, we actively explored the *feasibility of using the guidelines outlined in the EpiDoc framework* for encoding symbols and punctuation. Initially intended for encoding various symbols, these guidelines have proven to be compatible with Armenian inscriptions in some cases. By implementing these guidelines, we align our work with the recognized standards of EpiDoc while effectively accommodating the unique characteristics of Armenian inscriptions, including their distinctive use of punctuation marks and symbols.

The apparatus we are developing highlights the need for flexible and innovative solutions in contemporary research and preservation projects; we faced numerous challenges, some anticipated and others unexpected. In response, we did not extend our search for a variety of new tools but chose to enhance those that adapt quickly. Our apparatus effectively addresses these challenges by providing a comprehensive platform for capturing and organizing information. As we continue our work, the iterative process of collecting data, analyzing findings, and updating the apparatus will be integral. This apparatus is more than just a tool; it is a continuously evolving document that will be updated to meet the project's needs. Its development and implementation so far emphasize its importance and potential for future applications. Even in situations where physical access is restricted, digital tools and strategies, such as our apparatus, can bridge the gap and ensure continuous progress. This project serves as a model for similar initiatives, emphasizing the significance of resilience, collaboration, and innovation in preserving cultural heritage.

Our ongoing efforts to address the challenge of *creating a specialized Armenian vocabulary for digital epigraphy* are expected to yield significant results. We anticipate the development of a comprehensive Armenian vocabulary tailored to digital epigraphy. This vocabulary will encompass a wide range of facets related to inscriptions, including object types, monument types, inscription types, materials, preservation states, letter types, decoration, symbols, and execution techniques.

The term lists compiled as part of this vocabulary-building process will be transformed into XML files, each incorporating direct references to the EAGLE vocabulary where applicable. This integration with EAGLE vocabulary not only augments the depth and breadth of our term references but also connects our work to a broader global standard. Serving as invaluable internal references within our digital domain, these XML files will significantly enhance data categorization and accessibility, facilitating the precise classification of inscriptions.

The collaborative partnership with Yerevan Brusov State University of Languages and Social Sciences is expected to result in a glossary of terms commonly used in Armenian academia to describe inscriptions. Each term will be accompanied by clear and precise definitions, eliminating ambiguities and ensuring uniformity and accuracy within the field.

By studying the terminology used by prominent scholar Samvel Karapetyan, we anticipate enriching our vocabulary with nuanced and contextually accurate definitions. This analysis will provide a valuable resource for researchers, scholars, and practitioners in Armenian epigraphy.

The development of this specialized vocabulary is expected to contribute significantly to the standardization of terminology within Armenian epigraphy. Researchers and institutions working on digitizing and preserving Armenian cultural heritage will benefit from a consistent and precise lexicon.

Beyond facilitating data interoperability, standardized vocabularies offer substantial data discovery, retrieval, and reuse benefits. Employing a common vocabulary streamlines data search and retrieval, enhancing its discoverability. Standardized vocabularies simplify data reuse across various contexts and applications, promoting innovation and fostering collaborative endeavors.

In perspective, the results of this undertaking include *the integration of the Armenian epigraphic database into the Linked Open Data* [19]. Establishing standardized vocabularies assumes paramount importance in developing linked open databases, ensuring the structured and consistent alignment of data. These standardized vocabularies are the linchpin of data interoperability, enabling seamless integration and data sharing across diverse systems and applications. Linked open databases predominantly rely on machine-readable formats such as RDF and OWL to encode and store data, mandating standardized vocabularies, often called ontologies, which provide a shared understanding of data semantics. With standardized vocabularies, deciphering and extracting meaning from the data housed in linked open databases would be smooth.

Following the creation of the glossary, the subsequent step involves the construction of the SKOS (Simple Knowledge Organization System) framework [20,21]. This framework facilitates the attachment of labels to concepts in natural language, including

- *SKOS: prefLabel*—preferred terms,
- *SKOS: altLabel*—additional labels such as synonyms, abbreviations, and acronyms,
- *SKOS: hiddenLabel*—hidden labels designed for variants primarily employed in text indexing.

To bolster interoperability, concepts within the SKOS structure must be mapped with external vocabularies, with a particular emphasis on integration with the EAGLE project. SKOS provides properties for linking concepts to external resources, offering options for

- *SKOS property "exactMatch"*—precise matches,
- *SKOS term "closeMatch"*—near correspondences,
- *SKOS property "broadMatch"*—broader equivalents,
- *SKOS property "narrowMatch"*—narrower terms in external vocabularies.

Despite the challenges imposed by restricted access and geopolitical complexities, our project's resilience and innovative strategies allow us to continue our mission of preserving Armenian inscriptions. These results demonstrate the importance of adaptability and creativity in the face of unforeseen obstacles, ensuring the ongoing safeguarding of cultural heritage.

6. Conclusions

The journey of preserving Armenian inscriptions and cultural artifacts is fraught with complexities, both in the technical realm of documentation and the broader geopolitical landscape. Our project's experiences underscore the urgent need for adaptive and innovative methodologies in the face of ever-evolving challenges. Our successes, particularly

the discovery and documentation of inscriptions from St. Hakobavank church, emphasize the importance of community engagement and the power of leveraging digital tools like Google alerts.

The choice and further development of digitization tools play a key role in projects compiling epigraphic databases. DHAnnoto's innovative photographic and textual data integration significantly advanced our digital epigraphy efforts. The tool's user-friendly design and automated data extraction capabilities, despite not being tailored explicitly for epigraphy, greatly enhanced the efficiency of our work. DHAnnoto exemplifies the potential of adapting existing digital tools to new fields, showcasing the evolving landscape of digital humanities and its impact on cultural heritage preservation.

Using the Oxygen text editor was a strategic methodological choice that significantly streamlined our process of compiling the Armenian inscriptions database. Its versatility, robust support for XML-based encoding, and seamless integration with the EpiDoc schema have empowered our team to navigate the intricate landscape of Armenian epigraphy with precision and efficiency. This methodological foundation not only laid the groundwork for successfully realizing our project's objectives but also ensures that the rich heritage of Armenian inscriptions is preserved, enriched, and accessible for generations to come.

EpiDoc guidelines were the following incentive that improved the management and accessibility of Armenian inscriptions. They ensured that these invaluable artifacts of Armenian heritage would not only be preserved for posterity but also made readily available for scholarly research and analysis. This initiative was a pivotal step in safeguarding and promoting the rich epigraphic heritage of Armenia.

Of course, it would not work properly without an accurate adaptation of the EpiDoc guidelines to accommodate Armenian inscriptions. A certain amount of effort has been invested in the achievement of data and metadata precision and clarity of representation. The upgraded version will enable the comprehensive edition of the inscriptions, including diplomatic and interpretive transcription, translation, apparatus, commentary, and bibliography. This multifaceted approach ensures that the inscriptions are transcribed and subjected to thorough analysis and interpretation. While challenges, such as unique punctuation styles and scripts, symbols, etc. exist, we are still actively exploring solutions to maintain accuracy and consistency within the framework of this renowned XML-based standard.

Part of the solutions emerged due to leveraging the Grabar (Classical) Armenian dictionary, which enabled us to effectively navigate the complexities of the Armenian language, resulting in a more streamlined and accessible database through precise methodologies and the right linguistic tools. The enhancements, from improved search functions to accurate data representation, underscore the value of strategic decision-making in corpus architecture and data management. As the world of linguistics and database management continues to evolve, our experience stands as a testament to the importance of melding traditional linguistic knowledge with advanced computational techniques. Our refined database sets a robust foundation, aiding both present research and future linguistic explorations in Armenian studies.

In summary, this project represents a significant stride toward preserving and promoting Armenian epigraphic heritage within the digital landscape. Researchers and conservationists must think outside the box, employ a mix of traditional and modern techniques, and continuously adapt to changing circumstances. Despite the formidable challenges encountered, the project's unwavering commitment to methodological innovation underscores its role in advancing this field and ensuring that the rich cultural heritage of Armenia and its regions, even in the face of adversity, is never forgotten. The importance of our work is not just in the preservation of stone and text but in capturing the stories, hopes, and resilience of people and their enduring legacy.

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Notes

- 1 To explore further details regarding the history and current status of Artsakh, I recommend visiting the following link: https://en.wikipedia.org/wiki/Republic_of_Artsakh (accessed on 15 February 2023).
- 2 De Waal, Thomas. *Black Garden: Armenia and Azerbaijan Through War and Peace*. New York: New York University Press, 2003, pp. 175–176. Cox, Caroline. “Survivors of the Maraghar Massacre Archived September 29, 2007, at the Wayback Machine”. *Christianity Today*. 27 April 1998. Retrieved 20 December 2010.
- 3 To explore further details regarding the history and current status of Artsakh, visit Republic of Artsakh—Wikipedia.
- 4 The European Parliament resolution on the destruction of cultural heritage in Nagorno-Karabakh(2022/2582(RSP)) dated 10 March 2022
- 5 More detailed information on this matter can be found here. <https://news.am/eng/news/678914.html> (accessed on 15 February 2023).
- 6 https://www.osf.am/wp-content/uploads/2022/06/Fact-Finding-Report_FINAL_web.pdf (accessed on 13 March 2023); <https://armenpress.am/eng/news/1091044.html> (accessed on 15 June 2023); <https://fip.am/en/17184> (accessed on 15 June 2023); <https://evnreport.com/politics/integration-of-nagorno-karabakh-armenians-a-tool-for-subjugation-and-ethnic-cleansing-by-azerbaijan/> (accessed on 13 August 2023).
- 7 <https://heritage-digitaltransitions.com/ukraine-digitization-project/> (accessed on 2 April 2024); <https://www.gu.se/en/research/digital-documentation-of-inscriptions-in-the-saint-sophia-cathedral-in-kyiv> (accessed on 2 April 2024).
- 8 This project has received funding from the Swiss National Science Funding for 9 months starting on 1 June 2022 and for 12 months starting on 1 March 2023.
- 9 For in-depth and comprehensive insights, I suggest visiting the website <https://monumentwatch.org/en/> (accessed on 13 March 2022). This independent academic platform meticulously records and presents the state of Artsakh's cultural heritage and its dynamic transformations and provides expert commentary adhering to rigorous academic standards. The website offers detailed information, along with photographic evidence, pertinent to the ongoing discussion.
- 10 *ANNUAL REPORT 2021 College of Humanities, École Polytechnique Fédérale de Lausanne*, https://issuu.com/epfl-flash/docs/epf_cdh_ra2021_final_web2 (accessed on 15 June 2022).
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- 16 <https://www.facebook.com/photo/?fbid=1356424355285267&set=a.272406560353724> (accessed on 29 September 2023).

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