

The Digital Enhancement of a Discipline Byzantine Sigillography and Digital Humanities

Alessio Sopracasa

Université Paris-Sorbonne, France

Martina Filosa

Universität zu Köln, Deutschland

Simona Stoyanova

University of Oxford, UK

Abstract Byzantine sigillography is intrinsically interdisciplinary. Unlike other sister auxiliary disciplines, such as epigraphy or numismatics, sigillography has not yet benefited from the experience gained within the Digital Humanities. SigiDoc, the newborn encoding standard for Byzantine seals, is the first attempt to bridge this gap. This paper is aimed at investigating the interactive fusion of aspects of interdisciplinarity between Byzantine Sigillography and the Digital Humanities whilst illustrating the ‘digital genealogy’ of SigiDoc in the broader context of TEI, as well as its relationship of reciprocity with open source initiatives and tools, such as EpiDoc and EFES (EpiDoc Front-End Services).

Keywords Byzantine Sigillography. Byzantine Studies. Numismatics. Epigraphy. EpiDoc. Digital Scholarly Edition. EFES (EpiDoc Front-End Services). SigiDoc.

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1 Introduction. Byzantine Sigillography and Its Object: A Multi- and Interdisciplinary Field

Byzantine sigillography is the research field studying seals formerly attached to official documents in the Christian eastern medieval empire centred upon Constantinople. Sigillography is a pivotal discipline within the broader domain of Byzantine studies, because seals are the only remnants of the written documents used for daily administration and private correspondence from the 4th to the 15th century CE in the Byzantine Empire, whose public and private archives are nearly entirely lost. As such, seals do not supplement archival material but have to substitute it, which explains the unique importance of sigillography for Byzantine studies.

Byzantine seals are coin-like objects mostly made of lead, whose two sides display iconographic depictions and/or legends (i.e. inscriptions). They are produced with a matrix called *boulloterion* (a plier-like object), leaving an imprint on the two faces of the blank. We use the term ‘seal’ to refer to both the object and the imprint it bears.



Figure 1 Seal of Michael, vestarches and oikonomos of the Nea Church, mid-11th century (Collection Sopracasa, inv. no. 53; published in Sopracasa, Prigent 2017)

A large part of the 80,000 extant seals consists of unique specimens, which were the possession of a single individual or institution in Byzantium. Whilst the mass of seals provides insights into historical, administrative, and economic aspects of the Byzantine empire, each individual seal grants us access to the citizens of the empire, almost half of whom are attested only through their seals (Cheynet 2008, 74). Byzantine sigillography contributes significantly to the advancement of various research fields within the broader domain of Byzantine studies, such as prosopography, administrative geography, political, social, economic, and art history, epigraphy and philology. We argue here that Byzantine sigillography is intrinsically interdis-

ciplinary, with an extremely wide coverage of, and overlap with, other disciplines: sigillography shares issues, tools, solutions, and questions, with fields including epigraphy, numismatics, and art history.

1.1 Scholarly Editions in Byzantine Sigillography

It is important to highlight that, aside from a few attempts to give some very general guidance (Oikonomides 1986; Tsougarakis 1999; Cheynet 2008, 1-82), there are no manuals for Byzantine sigillography, and edition standards have been developed over the last century in a somewhat haphazard fashion in individual publications, never being systematically and unanimously established. Moreover, there is a lack of consistency in the use of edition criteria among scholars and their schools: the features that differ most are those of epigraphical rendering, normalisation of language variants of Byzantine Greek, consistent use of the Leiden conventions, iconographical analysis, and historical commentary.¹

Paper publication is the rule for Byzantine sigillographers. This materialises mainly in ponderous, limited-edition corpora² or small articles scattered in journals and miscellaneous books, the *Studies in Byzantine Sigillography* being the only journal that specialises in this field.³ Existing paper publications are not readily available, rather expensive, and do not allow for updating, amending, or improving. There are also significant issues of image quality (even if greater efforts have been made recently).⁴

1.2 Byzantine Sigillography and Digital Humanities

In the last few years, sigillography has received increasing attention from experts in Digital Humanities, Western Mediaeval seals being at the forefront.⁵ But this increased attention is far from being sufficient

1 This lack of consistency hinders the cross-referencing of information among different collections. See, e.g. Zacos, Vegler 1972; Seibt 1978; Zacos 1984; Oikonomides et al. 1991-2009; Seibt, Wassiliou 2004.

2 See most recently Cheynet, Bulgurlu, Gökyıldırım 2012; Cheynet, Campagnolo-Pothitou 2016; Cheynet 2019.

3 The journal is published every four years and the latest volume is *Studies in Byzantine Sigillography*, 13, 2019.

4 See, e.g. Cheynet 2019. One must notice, however, that the publication has been fully financially supported by the private collector whose seals have been edited, thus making the high definition of the images an exception rather than the rule.

5 See projects such as Sigilla (<http://www.sigilla.org/>) and DigiSig (<http://digi-sig.org/>).

to narrow the gap with sister auxiliary disciplines, such as numismatics, epigraphy, and papyrology, which, during the last 20 years, have developed their own digital approaches, stimulating the growth of online corpora. Unlike these disciplines, Byzantine sigillography has not yet benefited from the experience gained within the Digital Humanities. Within the scope of this paper, we discuss EpiDoc, an international, collaborative effort using a subset of the Text Encoding Initiative (TEI) that provides a standard, guidelines, and tools for creating and encoding scholarly editions of ancient texts and documents produced on various text-bearing objects other than parchment or paper, such as stone or papyrus.⁶ In the field of Byzantine sigillography the only consistent online presence is the ongoing Online Catalogue of the Dumbarton Oaks Research Library and Collection (Trustees for Harvard University) in Washington, DC, which holds the largest collection of Byzantine seals worldwide, with around 17,000 specimens.⁷

SigiDoc, the new encoding standard for Byzantine seals that has been developed since 2015 between Paris and Cologne by Alessio Sopracasa and Martina Filosa, is the first attempt to bridge this gap: the discipline is now ready to benefit fully from the method-oriented interdisciplinarity of the Digital Humanities, leveraging standards, tools, and practices developed in neighbouring disciplines and adapting these to its specific needs and materials.

SigiDoc is an XML-based and TEI-compliant encoding standard for producing digital editions of Byzantine seals and digitally enhanced versions of printed editions.⁸ It is largely based on the ongoing experience of TEI, EpiDoc, and EFES (EpiDoc Front-End Services) – a highly customisable platform for the online publication of ancient texts in EpiDoc XML, as will be illustrated in the examples below.⁹ The developers plan to release version 1.0 in the spring of 2021: a GitHub repository is already available with an in-progress version of

6 EpiDoc: Epigraphic Documents: <https://epidoc.stoa.org/>. For a list of projects related to inscriptions, coins, and papyri in Digital Humanities: <https://wiki.digitalclassical.org/Category:Projects> (updated to 2016-05-31).

7 See <https://www.doaks.org/resources/seals>.

8 See Sopracasa, Filosa 2020; see also “Sunokisis Digital Classics: Spring 2020. Session 5. EpiDoc 2: publishing and querying with EFES” (<https://github.com/SunoikisisDC/SunoikisisDC-2019-2020/wiki/DC-Session-5-EpiDoc-2>) and “Summer2020 Session 4. Text-Bearing Objects 2” (<https://github.com/SunoikisisDC/SunoikisisDC-2019-2020/wiki/Summer2020-Session-4>).

9 EFES is a fork of the open source XML publishing platform Kiln developed by the Department of Digital Humanities at King’s College London between 2012 and 2019. See <https://github.com/kcl-ddh/kiln> and <https://kiln.readthedocs.io/en/latest/> for the documentation. For a thorough analysis of EFES and its potential, see most recently Bodard, Yordanova forthcoming.

the code¹⁰ and a website (<http://sigidoc.huma-num.fr/>, empty for now) is ready to host documentation, guidelines, and general information about the project, as well as a test corpus consisting of a digitally enhanced version of a printed article (Sopracasa, Prigent 2017).

SigiDoc 1.0 will finally provide something that has been long awaited and discussed since 2006 amongst the community of Byzantine sigillographers, being something of a chimera for Byzantine studies at large, often announced but never seen.¹¹ However, we are aware that it can be improved and we have therefore tried to anticipate future developments and needs: a second round in SigiDoc's development is currently already seeking funding.

As already stated elsewhere (Sopracasa, Filosa 2020, 241), SigiDoc is:

- a schema, compatible with the EpiDoc and TEI All schemas;
- a template, i.e. SigiDoc's edition structure (partially reproduced below);
- a stylesheet for HTML transformation;
- a set of stylesheets for scholarly editions of the legends on seals;
- a highly customised version of EFES;
- a set of encoding guidelines;
- a set of files intended to be shared among all future SigiDoc projects (ID lists, controlled vocabularies, authority lists, ontologies etc.).

From a SigiDoc point of view, we consider Byzantine seals as compounds of three different, intrinsically intertwined, aspects: the object, the text, and the image. As objects, seals in many ways resemble coins, thus enabling sigillographers to leverage the experience gained in the neighbouring field of numismatics. As the study of text-bearing objects, sigillography utilises standards and criteria developed for editions of papyri and inscriptions, such as the Leiden conventions, whilst customising them to best suit the different kinds of material being treated. Finally, seals are also treated as images, both as digital facsimiles and as bearers of iconographic depictions. This paper, however, will only deal with the first two aspects. In addition, as a minor but relevant point, this paper will devote special attention to some aspects of the relationship between print and digital publication, whilst addressing the topic of the degree of digital enhancement of the discipline offered by the current state of SigiDoc.

10 SigiDoc's GitHub repository <https://github.com/SigiDoc/SigiDoc>. We invite potential users not to fork this repository yet, as it will be updated before releasing the 1.0 version.

11 A Wiki, last updated in 2011, illustrates the first round of discussions about SigiDoc: <http://sigidoc.wikidot.com/>.

2 The Seal as an Object: The Metadata

With regard to metadata on the EFES-generated webpage,¹² the structure of a SigiDoc edition will be similar to that of other EpiDoc-based projects.¹³ The digital edition appears more organised and better structured in comparison with the printed one, where the metadata are usually grouped, in a smaller font, under the main title of the seal, including a mention of the date (without dating criteria); the inventory number of the edited seal; its diameter (with no further measurements); a simple physical description, focusing mainly on the state of conservation of the seal; and, finally, a mention of its edition(s) and parallel(s), if applicable. As far as further metadata are concerned, these can be either found scattered within the commentary of the edition or are not registered by the editors at all. In SigiDoc, however, specific fields have been created to deal with these individual aspects of metadata. Examples of these include: *Channel orientation* and *Axis*, expressed with reference to the numbers on a clockface (e.g. thread channel at 1 o'clock) and mostly omitted by printed publications, the former showing the position of the thread channel in relation to the imprint, the latter showing the orientation of the imprint on the obverse in relation to the one on the reverse; *Seal's context*, *Issuer*, and *Issuer's milieu*, giving broad insights into the owner of the seal; *Acquisition* and *Previous Locations*, retracing the history of the seal until its current location; and *Decoration*, giving insights into borders and decorative elements on the seal.

Beyond making the information more structured, organised, and easily comprehensible, the encoding template prioritises some elements of the metadata which, in a printed edition, would be likely to go unnoticed. That is the case, above all, for the field *Lettering*, i.e. the information concerning the appearance of the letterforms on the seal, which is one of the key factors in the dating of a specimen.

Further, in the digital edition, there will inevitably be some blank fields in which the information is replaced by, e.g. an em-dash or by the use of the phrase *not applicable/not available*. After much discussion with our colleagues – sigillographers and digital humanists alike – on whether to delete those fields with lack of information, we concluded that the lack of information is still information *per se*.

12 Metadata are, from a SigiDoc point of view, all information contained in the TEI-header. They concern appearance and physical description of the seal; its dating and dating criteria; its history – ancient and modern alike – spanning, therefore, from the time of the seal's issuer until the acquisition of the seal in a collection; a description of both sides of the seal, including a thorough description of the iconography; and bibliographical references to the seal and to its parallels, when applicable.

13 For a glimpse of the layout of the prospective webpage generated through EFES see <https://iospe.kcl.ac.uk/5.48.html> (accessed: 2020-07-14).

2.1 Manuscripts with Seals and Seals without Manuscripts: TEI Standards and Byzantine Seals

In the ‘digital genealogical tree’ of SigiDoc, the oldest ancestor is represented by TEI, whose aim is “to develop and maintain guidelines for the digital encoding of literary and linguistic texts”.¹⁴ Even though this definition embraces a very wide range of texts, some are only marginally or approximately represented: this is true, e.g. for inscriptions and seals’ legends. The privileged supports of the texts considered by the TEI guidelines are those of paper or parchment, much less stone or lead: this becomes extremely clear upon reading the guidelines about the description of the text-bearing object, explicitly defined as “Manuscript description”, and, more broadly, the names chosen by the TEI consortium for the elements.¹⁵

This remark leads directly to the next generation of SigiDoc’s genealogy, i.e. EpiDoc. As a matter of fact, EpiDoc has been the starting point for the development of several aspects of SigiDoc, mainly because this standard, now long established, represents a selection and a semantical adaptation of TEI’s standards in a direction very suitable for – even if not entirely coincident with – sigillography. Hence, placed under the large umbrella of TEI, SigiDoc greatly benefited from the experience of (digital) epigraphy.

Whilst the elements chosen by SigiDoc are TEI, they no longer refer to a manuscript:

```
<TEI xmlns="http://www.tei-c.org/ns/1.0">
  <teiHeader>
    <fileDesc>
      <titleStmt/>
      <editionStmt/>
      <publicationStmt/>
      <sourceDesc>
        <msDesc>
          <msPart n="x"/>
          <msPart n="v"/>
        </msDesc>
      </sourceDesc>
    </fileDesc>
    <encodingDesc/>
    <revisionDesc/>
  </teiHeader>
  <facsimile/>
  <text>
    <body>
      <div type="edition" subtype="editorial" xml:space="preserve"
xml:lang="grc"/>
      <div type="edition" subtype="diplomatic" xml:space="preserve"
xml:lang="grc"/>
      <div type="apparatus"/>
      <div type="translation"/>
      <div type="commentary" subtype="edition"/>
      <div type="commentary" subtype="translation"/>
      <div type="footnotes"/>
      <div type="bibliography"/>
    </body>
  </text>
</TEI>
```

¹⁴ See <https://tei-c.org/about/>.

¹⁵ See TEI Guidelines §10, <https://tei-c.org/release/doc/tei-p5-doc/en/html/MS.html>.

As it shows, the basic structure of a SigiDoc edition structure is extremely close to that of EpiDoc, and it is organised around three main elements: the <teiHeader>, designed to collect the metadata; the <facsimile> for the images of the edited seals; and the <text> for the edition of the seals' legends, apparatus, and commentary, including bibliography and footnotes.¹⁶

A TEI element <sealDesc> does exist and, according to the TEI standards, it is designed to describe "the seals or similar items related to the object described, either as a series of paragraphs or as a series of seal elements";¹⁷ this element may contain only a handful of other ones, such as <p>, <ab>, <condition>, <decoNote>, <summary>, and, of course, <seal>, the latter being suitable for "a description of one seal or similar applied to the object described".¹⁸

These elements are manifestly not sufficiently detailed to properly encode a Byzantine seal, because – as the previously quoted definitions clearly show – the seal is considered as a part of the very object of the description, i.e. the manuscript, <sealDesc> being nested inside <physDesc>. This approach implies a strict interdependence between the document and the seal, which is neither consistent nor realistic with the material available to Byzantine sigillographers: as we saw before, due to the nearly complete loss of Byzantine private and public archives, finding a Byzantine seal still attached to the document it authenticates is extremely rare (Cheynet 2008, 13-14 with references).

The adoption of the TEI standards by SigiDoc involves, therefore, a semantic 'betrayal' of some of them or, in a more positive way, their semantic extension.¹⁹ This is particularly true for the metadata, all nested inside a <sourceDesc> element which, at least by its name, can be adapted to multiple materials, but which is extremely stretched by EpiDoc's and SigiDoc's use of it if we consider the role that TEI assigns to it.²⁰

¹⁶ For the structure of an EpiDoc edition see <https://epidoc.stoa.org/gl/latest/supp-structure.html>.

¹⁷ See TEI Guidelines <sealDesc>, <https://tei-c.org/release/doc/tei-p5-doc/en/html/ref-sealDesc.html>.

¹⁸ See TEI Guidelines <seal>, <https://www.tei-c.org/release/doc/tei-p5-doc/en/html/ref-seal.html>.

¹⁹ A lively and fruitful debate about this topic took place during the workshop "Digitizing and Encoding Seals: SigiDoc and RTI-Dome in Action", organised by the Venice Centre for Digital and Public Humanities at Ca' Foscari University, on January 20-21, 2020. For programme and teaching materials see: <https://www.unive.it/data/33113/2/35921>.

²⁰ See TEI Guidelines § 2.2.7 "<sourceDesc> (source description) describes the source(s) from which an electronic text was derived or generated, typically a bibliographic description in the case of a digitized text, or a phrase such as 'born digital' for a text which has no previous existence". Available: <https://tei-c.org/release/doc/tei-p5-doc/en/html/ref-sourceDesc.html>.

Next there is `<msDesc>`: in order to meet sigillographic needs and to upgrade the place of a seal, assigning to it a central role, it should hypothetically be replaced by the already mentioned `<sealDesc>`. If SigiDoc's use of `<msDesc>` does not strictly respect its semantics, one should also stress that the TEI consortium intends the *msdescription module* as "general enough" to be "extended [...] and [...] potentially useful for any kind of text-bearing artefact",²¹ even if the original aim, i.e. working with Mediaeval manuscripts, is predominant. This clarification has been introduced in the current TEI Guidelines (P5) since the 1.0.0 version dating back to 2007; most recently, for the latest release (4.0.0), the consortium wanted to stress further and clarify that the `<msDesc>` element could be used for all text-bearing objects.²² A discussion took place about the possibility to expand the semantic area of `<msDesc>`, changing it to `<TBODesc>` (for text-bearing object description), but the idea was soon abandoned, because the priority was given to backward compatibility, concluding that any `<ms*>` element could and should be used for *any* text-bearing object.²³

2.2 Seals as Coin-Like Objects: Seriality vs (Relative) Unicity

Coins share some key features with seals, such as two faces, the presence of images and inscriptions, materials, and techniques of production. Coins are the closest objects to seals having already benefited from an important digital attention and they also have 'their own TEI', i.e. the Nomisma project.²⁴ Its Numismatic Description Schema/Standard (NUDS) is XML-based and influenced by the structure of, among others, TEI.²⁵ Looking at what neighbouring disciplines had found in order to represent their data in digital form, in one of SigiDoc's previous development steps, Alessio Sopracasa, at that time the sole developer, tried to evaluate the possibilities of a close interaction between SigiDoc and NUDS, designing a template for the metadata of the seals based on NUDS, but largely adapted to the needs of sigillography, with its own schema to validate it, thereby seriously discuss-

²¹ See TEI Guidelines § 10.1, <https://tei-c.org/release/doc/tei-p5-doc/en/html/MS.html#msov>.

²² TEI Consortium (2020-02-13). TEI P5: Guidelines for Electronic Text Encoding and Interchange (Version v 4.0.0). Zenodo. <http://doi.org/10.5281/zenodo.3667251>, and the discussion: <https://github.com/TEIC/TEI/issues/1835>.

²³ This discussion took place on the TEI-List on 2018-09-28, see <https://listserv.brown.edu/cgi-bin/wa?A2=ind1810&L=TEI-L&P=72748>.

²⁴ See <http://nomisma.org/>.

²⁵ See <http://nomisma.org/nuds> and <https://www.greekcoinage.org/nuds.html>.

ing the possibility of adapting NUDS for SigiDoc.²⁶ Traces of this attempt are still visible today in NUDS, where sigillographic elements (or elements used in a ‘sigillographic way’), have been included:

- <channelOrientation> is an exclusively sigillographic feature, as it represents the channel through which the thread attaching the seal to the document passed;²⁷
- <date> and <dateRange> have been included inside both <obverse> and <reverse>, because seals may be struck by means of an assembled matrix, whose two sides date to a (slightly) different timeframe;
- <ab>, borrowed from TEI and added “for greater flexibility in the encoding of prose”: this is the element used by EpiDoc and, now, SigiDoc to encode inscriptions on stone and legends on seals;²⁸
- more generally, NUDS now “allows for the optional namespacing of EpiDoc TEI elements for legends and descriptions for more complex tagging of inscriptions and prose”.²⁹

Beside some minor additions, it seems clear that the inclusion of the TEI-EpiDoc features in the numismatic description was intended to provide the user with much more latitude, particularly for tagging the legends, as explicitly stated in the description of NUDS’ element <legend>: “Typically, the legend will be a *literal transcription* [...]. Alternatively, one or more <tei:div> elements may be namespaced in for a greater degree of transcriptive accuracy, following the EpiDoc schema”.³⁰

This kind of addition is not accidental: in the editions of coins, the legend is in plain text without editorial intervention, reproduced as it appears on the coin, and followed (or preceded) by a short description of the iconography – the main focus of the edition being the numismatic identification by means of the typological description (so as to obtain a ‘coin-type’) and references to standard works.³¹ It is precisely here that coins and seals differ the most: the seriality of coin production is far greater than that of seals. Suffice it to say that coins are usually found in hoards, whereas seals are mostly found

26 This attempt was made during Alessio Sopracasa’s Marie Curie fellowship at King’s College London, between 2015 and 2016. For a report on the activities see: <https://cordis.europa.eu/project/id/655492/reporting/fr>.

27 See <http://nomisma.org/nuds#channelOrientation>.

28 See <http://nomisma.org/nuds#ab>.

29 See <http://nomisma.org/nuds#toc-elements>.

30 Italic added. See <http://nomisma.org/nuds#legend>.

31 See, e.g. a bronze of Diocletian from the online collection of the American Numismatic Society (<http://numismatics.org/collection/1944.100.4191>), with the standard reference to the *Roman Imperial Coinage* catalogue (RIC) and the link to the typological description (<http://numismatics.org/ocre/id/ric.6.anch.54a?lang=en>).

as single specimens. Thus, in Byzantine sigillography each specimen counts and every part of it needs to be thoroughly investigated, especially legends and iconography. This was one of the reasons why the rapprochement between SigiDoc and NUDS was not as effective as initially thought: the core elements necessary to the former were external to the latter.³²

However, far from being unhelpful, this attempt was interesting for SigiDoc with regard to the metadata. NUDS is a very good working example of a standard for the description of objects closely related to seals, and this had its share of influence on the future development of SigiDoc. However, since NUDS counts TEI among its inspirations, the difference between the two standards lies sometimes solely in the name of elements that have, after all, the same function - names more discipline-oriented and semantically consistent in NUDS than in a SigiDoc-adapted <teiHeader>. The clearest examples of this difference are in the NUDS elements <obverse> and <reverse>, for which SigiDoc uses <msPart> nested inside <msDesc>.

Here is an example for the obverse of the seal in fig. 1:³³

```
<msPart n="r">
  <msIdentifier>
    <idno/>
  </msIdentifier>
  <msContents>
    <summary n="r">
      <seg xml:lang="en">Obverse</seg>
    </summary>
  </msContents>
  <physDesc>
    <objectDesc>
      <layoutDesc>
        <layout n="r">
          <dimensions type="written" unit="mm">
            <dim type="diametre"/>
          </dimensions>
          <crs type="layout">
            <seg xml:lang="en">Iconography</seg>
            <seg xml:lang="fr">Iconographie</seg>
          </crs>
          <p xml:lang="en">Iconography</p>
          <p xml:lang="fr">Iconographie</p>
        </layout>
      </layoutDesc>
    </objectDesc>
    <handDesc>
      <handNote n="r">
        <seg/>
      </handNote>
    </handDesc>
    <decoDesc>
      <decoNote>
        <figure>
          <figDesc n="r">Buste de saint Michel, au nimbe de grénetis, tenant dans la main
            droite un long sceptre orné de trois boules dans sa section supérieure;
          </figDesc>
          <figDesc n="decoR">Bord non identifiable</figDesc>
        </figure>
      </decoNote>
    </decoDesc>
  </physDesc>
  <history>
    <origin>
      <origDate>
        <seg xml:lang="en"/>
      </origDate>
      <date/>
    </origin>
  </history>
</msPart>
```

³² NUDS being not TEI-compliant played a major role in the unsuccessful rapprochement between NUDS and SigiDoc, as this would have involved losing all the infrastructure related to TEI.

³³ The structure of the reverse is identical, except for the @n's value, which is "v".

The seriality in numismatics and sigillography involves the use of tools in the production of these objects: the die (for coins) and matrix (for seals) can strike a series of identical objects. However, in numismatics this feature is not as prominent as it is in sigillography. In this lies a methodological difference: the seals struck by the same matrix represent a specific category in sigillography, so-called ‘parallels’ or ‘parallel seals’. In sigillographic editions, known parallels should always be cited: they help in the reading of a damaged seal, the number of extant parallels might represent an element discussed in the commentary, or, further, they allow for the reconstitution of the lost matrix from which they come.

2.3 A Digital Identity for Byzantine Seals

Matrices and parallels bring us back to the medium of publication. What is regrettably lacking in traditional sigillography is the unambiguous identification of the specimens. Whether belonging to a private collection or to a public archive, each seal has an inventory number, which is modelled according to changing criteria internal to each holding institution, thereby hindering cross-references across collections and publications. One of the major achievements of a digital scholarly edition in SigiDoc is that a unique identification number will be assigned to each seal. The importance of this feature becomes even clearer when it comes to parallel seals: aside from attributing a unique ID to each seal, it is of paramount importance to gather all the seals coming from the same matrix and bearing the same imprint. This is done by modelling an ID composed of a part shared by all the parallels and a part pinpointing each individual seal. The ultimate goal is to identify the matrices. One must note that, compared to the estimate of 80,000 extant Byzantine seals, only six matrices survive nowadays, hence a proper identification of the parallels would allow for a virtual reconstruction of the countless missing matrices. It is in this respect that the seriality of the seals’ production appears more clearly and that is the reason why SigiDoc also attributes a unique ID to the matrices, thus enabling the gathering of all the seals produced by a given matrix. Stretching this approach further, it is also possible to think that, in some cases with seals with a significant number of parallels, Byzantine sigillography, too, could develop the concept of ‘seal-type’, similarly to numismatics. This is the path taken by the project Sigilla, where a seal-type is virtually reconstructed from a number of specimens belonging to the same seal issuer.³⁴ Finally, the IDs are essential when it comes to overstrikes: just like coins, seals

34 See <http://www.sigilla.org/>.

may be struck twice or more, leaving us with two or more imprints on the same support. This means that the ratio ‘one imprint equals one object’ no longer applies, and the IDs ought to express this new situation clearly enough to be understood.

3 The Seal as a Text-Bearing Object

3.1 The Editions of the Legend: Diplomatic, Interpretive, Digital

The diplomatic and interpretive editions are displayed by SigiDoc in two different tabs in our EFES visualisation and, consistently with all EpiDoc projects which use this platform, the XML markup of the legend is available in a third tab. Conversely, unlike EpiDoc, in SigiDoc the two editions are placed within two separate <div>s, as shown by the code snippet on page 107 and as discussed in the following sections.

3.1.1 The Diplomatic Edition and the Epigraphy of a Seal: Typological vs Visual Rendering of Lettering

The semantic content of the legend of a seal is not the only meaningful aspect. The transcription of the characters ‘as they appear’ on the seal is the first step towards a scholarly edition of a legend. Nevertheless, there is no established practice in the rendering of the lettering among Byzantine sigillographers, thus leading to a variety of outputs. Here follow examples of diplomatic editions of six different seals from publications dating from 1884 to 2019:

ΚΩΝ (JOUR ΚΩΝΣΤΑΝΤΙΝΟΣ) [Β'(σελίκαφ) Α'C] ΠΑΘ'(αριος) S ΕΠ(ι) Τ'(ου) [Χ]ΓΚ[Α'(νεα)

Figure 2 Schlumberger 1884, 469
no. 8. Collection Schlumberger, s.n.

ΜΕΡ, Α
ΣΠΑΘ'ΚΡ, Τ
ΠΙΤ, ΙΠΠΙΟ
ΔΡΟΜ, ΣΜΥ
C . ΟΛΕ . .
. CΟΛ .
M,

Figure 3 Laurent 1981, no. 153.
Fogg Museum of Art, inv. no. 244

..ERO.
Θ,ΚΩΝCΤΑ.
.INΩR,CIΠA.
.POK..ΔI.
SEΠITΩN.
APRAP

Figure 4 Seibt, Wassiliou 2004, no. 24.
Münzkabinett des Kunsthistorischen Museums Wien, inv. no. 470

+ KER'Θ' | ANACTA | CIΩTΩ | KVPI | TÇH

Figure 5 Jordanov 2006, no. 390.
Archaeological Museum Veliki Preslav, inv. no. 21588

+KERVΘ|TWCΩΔ|ΔAMHAN|CΠAΘPΚ|ΔΔΤΟΔΑ|ΛΑCΝ

Figure 6 Cheynet 2008, no. 9.
Collection Zacos, Bibliothèque Nationale de France, inv. no. 225

ΒΑΡΔΑ
Β'CΠ'ΣΔΟ
ΜΕÇΤΙΚ'Τ'
ΝΘΜΕΡ

Figure 7 Dumbarton Oaks Online Catalogue.
Dumbarton Oaks Collection, inv. no. BZS.1955.1.716³⁵

From its very beginning, one of the major questions raised by Sigi-Doc's development was how to produce a diplomatic edition of the legends on the seals, i.e. how to render the lettering. Sigillography shares this issue with epigraphy, but the scarcity of the available space – and the problems it raises – brings the seals even closer to the coins. The need for a (digital) instrument allowing for a better understanding of the evolution of the lettering and, more generally, of the writing practices, as well as of improving and simplifying the scholarly activity, is already a *desideratum* for other sister dis-

³⁵ Available on <https://www.doaks.org/resources/seals/byzantine-seals/BZS.1955.1.716/view>.

ciplines. Scholars in numismatics now increasingly devote attention to the legends of the coins³⁶ – attention that was beneficial for projects in Western Mediaeval seals, too – by means of the development of dedicated fonts.³⁷

A different approach has been developed by Archetype for the study of palaeography.³⁸ Built on its predecessor DigiPal, Archetype is an open-source web-based suite of tools for the study of handwriting, palaeographical features, and iconography. The scholar defines a highly structured taxonomy of descriptions of characters, allographs, their components and features. These descriptors are then used to annotate images and further, to search, compare, and sort through scripts, characters, scribal hands etc., providing also a quantitative approach to, e.g. tracing the evolution of scripts or identification of scribes.

In epigraphic and papyrological editions a diplomatic transcription records the characters extant on the support, without any editorial intervention, as is the practice in EpiDoc. This diplomatic view, however, does not attempt to represent letterforms, ligatures, and decorative elements graphically.³⁹ Considering the wealth of inscribing traditions, scripts, variations of letterforms and ligatures within the wider EpiDoc community, it would be impossible and impractical to attempt faithful visual representation in the diplomatic view, not least because individual characters are identified in Unicode code points. Thus, the diplomatic transcription is considered complementary to photographs/drawings.

Conceptually, with SigiDoc the choice has been between a typological and a visual rendering of the characters. With the former solution, what counts is the presence of the main types of letters, variant letters, and ligatures rather than the completeness of the palette, and it is aimed at creating broad categories of single letter types; conversely, the latter option aims at exhaustiveness and is intended to reproduce as faithfully as possible the appearance of all the characters, thus making the palette constantly grow as new editions appear. SigiDoc ultimately chose the visual rendering through a specialised font called Athena Ruby.

In Byzantine studies, a ground-breaking True Type font for polytonic Greek called Athena, suitable for the diplomatic edition of both coins and seals, was developed at Dumbarton Oaks under the super-

36 See Codine 2013 as well as an online report by the same author titled *Epigraphie monétaire mérovingienne: nouveaux outils et nouvelles perspectives*: <http://www.archeologiesenchantier.ens.fr/spip.php?article161>.

37 The project Sigilla is planning to update its legends' transcriptions thanks to the achievements of the PIM project (about which, see Codine 2013).

38 See <https://archetype.ink/#top>.

39 For further discussion, see the EpiDoc Guidelines <https://epidoc.stoa.org/gL/latest/trans-diplomatic.html> and the MARKUP-list.

vision of the late Nicolas Oikonomides, historian of Byzantium and eminent sigillographer, and used by him for the first time in 1986 (Kalvesmaki 2015, 122): the goal was “to give sigillographers direct control over nuances in the typography” in order to, e.g. “choose variant letterforms and ligatures”.⁴⁰ It represents a typological, abstract rendering of the lettering found on Byzantine coins and seals. This font is used in fig. 6 above and it is nowadays the specialised font most frequently used by Byzantine sigillographers, despite it not being the standard, as figs. 4 and 5 clearly show.

Moreover, Byzantine sigillography can count on a font (used in fig. 7) which is an answer to the above-mentioned *desideratum*. This font is called Athena Ruby and it was conceived as both an evolution of Athena and its unification with other fonts for coins developed at Dumbarton Oaks under the project management of Joel Kalvesmaki. Athena Ruby – OpenType and Unicode-compliant – is specifically designed for the epigraphy of Byzantine coins and seals, and goes in the direction of what we called a ‘visual rendering’ of the legend. This font “has been designed to anticipate the needs of digital projects that use XML, JSON or other structured text formats”, and the wish of its developers is the inclusion of Athena Ruby in projects using EpiDoc standards.⁴¹ Accordingly, SigiDoc encourages its use and the encoding for the diplomatic edition is as follows:⁴²

```
<c type="glyph" ref="glyphs.xml#Alpha.2">A</c>
```

Should, then, Athena Ruby be used to replace the images? Its glyphs are intended to be “idealized replicas of letterforms” and are, more precisely, “meant to evoke, but not replicate, types of letters”.⁴³ Nevertheless, one should note that Athena Ruby has, e.g. twenty-eight variants of the Greek letter alpha,⁴⁴ whereas Athena only six, and, further, that the former has an ever growing palette.⁴⁵ The trend is clearly that of replicating the letterforms as faithfully as possible without, however, aiming at photographic exactness. Using an ev-

⁴⁰ See <https://www.doaks.org/resources/athena-ruby>.

⁴¹ Kalvesmaki 2015, 123; on Athena Ruby, see also Codine-Trécourt, Sarah 2012, 276-7.

⁴² The only technical infelicity is that Oxygen editor reads Athena Ruby only in Author Mode.

⁴³ See <https://www.doaks.org/resources/athena-ruby/users-manual>.

⁴⁴ Database of the Athena Ruby Glyphs (HTML): <https://www.doaks.org/resources/athena-ruby/database-of-characters-in-html>.

⁴⁵ The font is now under the management of Colin Whiting at Dumbarton Oaks and periodical additions of new characters will henceforth take place (on a biannual rhythm) concurrently to the upcoming publications of seals in the Dumbarton Oaks collection – as Whiting told us *per litteras*.

er-growing font like Athena Ruby will give SigiDoc (and Byzantine sigillographers) an increased and 'atomic' character-level searchability of the text's lettering as well as a more accurate analysis of the evolution of the sigillographic epigraphy, one of the major criteria for dating a seal. Scholars of Byzantium have already delivered some important contributions to our knowledge of the epigraphy of Byzantine coins and seals (Oikonomides 1986, 165-9; Morrisson 1994; Oikonomides 2004), but the constant increase in the number of published seals results in a constant expansion of this knowledge. The font's effectiveness will be enhanced by its inclusion in SigiDoc: the epigraphy will be contextualised thanks to the other data available, such as dating, places, social milieu of the seal's issuer etc., all materialising in a search form that takes all these factors into account.

The main difference between Archetype's approach to the script and the one using Athena Ruby lies in their ultimate goal. Archetype provides a framework and methodology for palaeographical analysis that can be adapted to a wide range of alphabets, scripts, and decorative elements, based on the comparison of structured descriptions provided by specialists in their respective fields. Here the standardisation comes in the approach, methods, and tools, rather than in any specific vocabulary used for the distinct letter components.

The idea underlying the development of Athena Ruby is, however, to develop a shared editorial standard for the diplomatic edition. This is arguably beyond the scope of both palaeography and epigraphy, and intrinsic to Byzantine sigillography and numismatics. It aims at providing sigillographers with a single point of reference for the diplomatic transcription in a critical edition, which is both Unicode-compliant (and thus computationally solvent) and reflective of the disciplinary requirements in this particular publishing tradition. Nevertheless, Athena Ruby is still little used by Byzantine sigillographers, and sometimes, when used, its richness is not fully exploited. In order to be properly used, it is good scholarly practice to fully exploit its palette, otherwise - with an inaccurate character choice - there is a danger of providing the readers with the wrong idea of the epigraphy. Paradoxically, the wide range of choice offered by this font has constituted a deterrent to its use, and for a valid reason: Athena Ruby allows for more subjectivity in the diplomatic edition, thus multiplying the possibilities of mistakes. However, 'subjectivity' here stands for 'editorial choices' and every edition largely relies on them: a large palette pushes us to be more detailed and this is a *desideratum*, which, of course, makes the work harder. It is true that sometimes, e.g. with a damaged seal, the degree of speculation is very high. For this reason and to limit the subjectivity, SigiDoc allows character-level queries not only as Athena Ruby variant, but al-

so under the normalised Greek version of the letter they represent.⁴⁶

In light of these issues, the question asked above ought to have a negative answer: Athena Ruby cannot and will not replace the images.

3.1.2 The Interpretive Edition: Layers of Leidenisation

The genetic ancestry from EpiDoc to SigiDoc is self-explanatory when it comes to the seals' legends: the experience gained by EpiDoc on inscriptions has been crucial for the establishment of accurate edition standards for seals in SigiDoc. EpiDoc is a well-established and widely used standard for scholarly editions of epigraphic material which does not need any presentation; Charlotte Roueché and Julia Flanders explained to epigraphers that:

the EpiDoc customization removes irrelevant elements from the main body of the TEI, and it adds provisions for the specific kinds of transcription, analysis, description, and classification that are essential for epigraphic work. The result is a simple yet powerful language which can be used to mark all of the significant features of inscriptions and also represent the accompanying information about the epigraphic object itself.⁴⁷

SigiDoc did the same with EpiDoc. The interpretive edition shows the intervention of the editor on the text itself, primarily through the application of conventions for the representation of non-verbal information such as lacunae, abbreviations etc., with symbols, brackets, and dots; the implementation of these rules is called by SigiDoc 'leidenisation', from the well-known Leiden conventions.⁴⁸

In relation to this, one of the major problems in sigillography is the lack of consistency found in printed editions. One of SigiDoc's main objectives is the spreading of established and well-rounded edition criteria: this achievement will not only improve the quality of the scholarly edition, but will also enable effective interoperability and easier searchability across corpora. At the same time, consistency is ensured by the use of an encoding standard enforced by the machine, thus removing approximation. Nevertheless, the willingness of scholars to accept rules that are not always in accordance with their habits will be a major factor in the success of this approach.

⁴⁶ Taking the above-mentioned example of the alphas, the variants - e.g. Α, α, ᾶ, ἄ, ᾶ, ᾶ etc. - will be also indexed and made searchable under the generic Greek alpha (Α).

⁴⁷ C. Roueché, J. Flanders, *Gentle Introduction To Mark-up for Epigraphers*, available: <https://epidoc.stoa.org/gL/latest/intro-eps.html>.

⁴⁸ See Galsterer 2006 with previous literature.

The leidenisation developed for SigiDoc can be summarised in four major groups, the first two being by far the most important and common ones:

- transcription: this concerns mainly lost or illegible lines or characters, as well as the lines organising the text and the words split across lines;
- editorial intervention: restoration of characters, expansions of abbreviations, omissions or corrections, and resolutions of monograms;
- form and appearance: of very limited use, as the use of Athena Ruby has been preferred;
- interpretation: mostly limited to numerals, uncommon on seals.

Alongside the selection of the TEI-EpiDoc criteria, the visualisation of these tags after transformation has sometimes been slightly modified, especially for the element <gap>.

Whilst the interpretive edition includes the encoding of the legend's text, in the diplomatic edition, features such as lost characters and ligatures are represented with Athena Ruby and encoded accordingly as characters. Here follows an example of both diplomatic and interpretive edition of the legend of the seal in fig. 1:⁴⁹

Diplomatic edition: +KER,Θ,|MIXAHΛ|RECTAPX|.OIKONO|.THCN.|.C

```
<div type="textpart" subtype="face" n="rev" rend="linear">
  <ab>
    <lb n="1"/><c type="glyph" ref="glyphs.xml#Kappa.1" subtype="K">K</c>€<c
type="glyph" ref="glyphs.xml#Beta.1" subtype="B">R</c>;Θ,
    <lb n="2"/><c type="glyph" ref="glyphs.xml#Mu.1">M</c> IX<c type="glyph"
ref="glyphs.xml#Alpha.2">A</c> HA
    <lb n="3"/><c type="glyph" ref="glyphs.xml#Beta.1">R</c>€CT
<c type="glyph" ref="glyphs.xml#Alpha.2">A</c> PX
    <lb n="4"/>.OI<c type="glyph" ref="glyphs.xml#Kappa.1">K</c>ONO
    <lb n="5"/>.THCN.
    <lb n="6"/>.C
  </ab>
</div>
```

Interpretive edition: +K(ύρι)ε β(οή)θ(ει) Μιχαήλ βεστάρχ(η) [(καί)]
οίκονο[μ(ω)] τῆς Ν[έα]ς

⁴⁹ For the sake of clarity, we reproduce here only the encoding referring to Athena Ruby characters differing from the standard Byzantine Greek alphabet, i.e. for A (alpha), R (beta), K (kappa), M (my).

Upon seeing this, users of EpiDoc will not be bewildered and this could be an important factor in the wider use of SigiDoc in the future.

A scholarly edition, though, would not be complete without a critical apparatus. While it is a common feature of printed editions of texts and inscriptions, a place specifically devoted to variant readings and discussions of editorial choices is usually missing in current sigillographic publications; these topics are discussed – in varying degrees of detail – as part of the commentary. We argue that having a specific place to discuss more technical aspects of the legend’s edition, without burdening the commentary, could push sigillographers to be more explicit in their editorial processes and methods, greatly benefiting current and future colleagues. For example, whether normalising the spelling of a word in the edition, mentioning the normalisation in the apparatus, or preserving the original spelling and discussing it in the apparatus, is a typical editorial choice that SigiDoc leaves to editors. In the current state of its development, SigiDoc indexes the normalised version of the words. However, the original (declined or conjugated) word is available in an index of lemmata, generated by means of tokenisation and lemmatisation of the legend, the former being defined as the “explicit mark-up of words” and the latter as the “identification of their dictionary headwords”,⁵⁰ through the element <w> and the attributes @lemma and @lemmaRef. Despite being specifically designed for words not included in the categories of terms to which a specific index is devoted, nothing prevents the user from adopting this markup for all terms. In this way, both normalised and original spellings will be searchable, which represents a major step forward for Byzantine sigillography and for its philological implications. Using the appropriate TEI elements,⁵¹ the apparatus avoids “the idea that texts exist outside the dialectic between documents and editors, and that editions can possibly establish texts once and for all” (Pierazzo 2016, 6).

This leads directly to one of the main advantages and challenges derived from a digital edition of Byzantine seals, i.e. fluidity (Sahle 2016, 29). This becomes especially evident in the edition of the legend, but concerns all aspects of the editorial work. SigiDoc will enable sigillographers to easily update and emend their editions. Editions of seals are usually reviewed in specialised journals, emended in other publications, and the same scholars can change their own views on an edition they published in the past. All this important information, instead of remaining scattered among several publica-

50 EpiDoc 9.1 Guidelines, Word and Lemmatization: <https://epidoc.stoa.org/gL/latest/idx-wordslemmata.html>.

51 See TEI Guidelines § 12, <https://www.tei-c.org/release/doc/tei-p5-doc/en/html/TC.html>.

tions, will be directly integrated into the digital edition, ‘socialising’ it and making it more collaborative. Virtually, the final word will never be written and the SigiDoc edition will always hold the best possible version of the knowledge regarding each seal without separate fascicules of *addenda et corrigenda*, provided the editors are sufficiently careful in updating their material.⁵²

It is obvious that the updates and the amendments present another question: what to do with older versions of an edition? This topic is particularly sensitive for ongoing editions of large amounts of material, such as sigillographic corpora encoded in SigiDoc, because the increasing number of seals will necessarily lead to a better or different understanding of previously edited material. SigiDoc 1.0 will be able to record these changes in the critical apparatus for the legend, or in plain text with regard to other aspects of the edition: a stable solution for a proper versioning is part of the work already planned for SigiDoc’s future development.⁵³

3.2 The Seal as a Meaning-Bearing Object: Semantic Annotation

Alongside the peculiarities of a strictly sigillographic analysis, which focuses on the seal as an object and on the markup of the legend as explained above, what matters most is the information these data convey. They represent the historical information extracted from a single seal and transcending the seal itself to become a source, possibly related to others of non-sigillographic nature and thereby significantly feeding the historical debate.

The first step in this direction is to allow the editors to extract what they consider to be the most important data coming from the seals they are working on: this usually takes the form of indices. With regard to sigillographic printed editions, indices are mostly available in larger corpora, but not in journal articles, with the praiseworthy exception of those published in the above-mentioned *Studies in Byzantine Sigillography*. All these indices are published to very different degrees of detail, and the choice of which terms should be indexed is variable. There are corpora which index separately proper names, dignities, and functions of the clergy and non-clerical ones (Zacos 1984; Zacos, Veglery 1972); corpora giving special atten-

⁵² Nevertheless, it must also be considered that the timeframe of the publication of the amendments does not always depend on the will of the editors. E.g. some hosting platforms are not keen to accept frequent uploads with new versions of the material. We plan therefore to deliver batches of digital *addenda et corrigenda* once a year. Fluidity also raises the issue of the authorship, connected to the easy reuse of the XML data.

⁵³ On the topic of versioning for scholarly editions see most recently: Bleier, Winslow 2019 and Bürgermeister 2020.

```
<div type="textpart" subtype="face" n="rev" rend="linear">
  <ab>
    <lg type="legendsCases" ref="legendsCases.xml#Dat">
      <1>
        <lb n="1"/>
        +
        <rs type="invocation" ref="invocation.xml#Κύριε" rend="linear">
          <w lemma="Κύριος"
lemmaRef="http://www.perseus.tufts.edu/hopper/morph?l=kurie&la=greek">
            <expan>
              <abbr>Κ</abbr>
              <ex>ύρι</ex>
              ε
            </expan>
          </w>
          <w lemma="βοηθέω"
lemmaRef="http://www.perseus.tufts.edu/hopper/morph?l=bohqeia&la=greek">
            <expan>
              <abbr>β</abbr>
              <ex>οή</ex>
              <abbr>θ</abbr>
              <ex>ει</ex>
            </expan>
          </w>
          </rs>
          <lb n="2"/>
          <persName type="unattested" ref="prosopography.xml#Μιχαήλ_1">
            <name>Μιχαήλ</name>
          </persName>
          <lb n="3"/>
          <rs type="dignity" ref="dignities.xml#βεστάρης">
            <expan>
              <abbr>βεστάρη</abbr>
              <ex>η</ex>
            </expan>
          </rs>
          <lb n="4"/>
          <w lemma="καί" lemmaRef="http://www.perseus.tufts.edu/hopper/morph?
l=kai&la=greek">
            <supplied reason="lost">
              <expan>
                <ex>καί</ex>
              </expan>
            </supplied>
          </w>
          <rs type="officeCivil" ref="officeCivil.xml#οικονόμος_της_Νέας">
            <expan>
              <abbr>
                οίκονό
                <lb n="5" break="no"/>
                <supplied reason="lost">μ</supplied>
              </abbr>
              <supplied reason="lost">
                <ex>φ</ex>
              </supplied>
            </expan>
          <w lemma="ὅ" lemmaRef="http://www.perseus.tufts.edu/hopper/morph?
l=ths&la=greek">τῆς</w>
          <placeName ref="geography.xml#Νέα">
            Ν
            <supplied reason="lost">
              ε
              <lb n="6" break="no"/>
              α
            </supplied>
            ς
          </placeName>
        </rs>
      </1>
    </lg>
  </ab>
</div>
```

tion to iconography and metrical legends (Jordanov 2006; Cheynet, Campagnolo-Pothitou 2016) and others which do not register either (Oikonomides et al. 1991-2009); whilst in the *Studies in Byzantine Sigillography* all terms deemed relevant are grouped under a single, broad category, named “Index of proper names and terms”, followed by an iconographic index. It is clear that such an approach, lacking common rules, hinders the analogical interoperability of these indices. Despite being time-consuming and not always as effective as hoped, this perusal of published material remains one of the first and unavoidable steps in studying a Byzantine seal, as it is necessary to ascertain whether the seal has already been published and whether parallels exist.

SigiDoc solves this shortcoming by means of the semantic encoding of the legends: this markup, aimed at extracting the most valuable information coming from the material, has been designed to work best with the EpiDoc Front End Services publishing platform (EFES). EFES provides SigiDoc with two major assets: web visualisation and data valorisation, which is expressed in customisable, automated indices and faceted federated search. Knowing that EFES allows for the creation of a potentially unlimited number of indices, the developers of SigiDoc encourage its users to prepare a common set of indices, to ensure optimal cross-referencing across different corpora.

Table 1 Suggested shared indices in SigiDoc corpora

Editorial and Philological Features	Prosopography and Geography	Sacred Nomenclature	Iconography
Abbreviations	Personal names	Invocations	Iconography
Monograms	Place names	Marian terms	
Glyphs	Dignities	Christ-related term	
Lemmata	Offices	Saints-related terms	
Legends' cases			
Metrical legends			

The indices are generated on the basis of Authority Lists used in EFES, to which the markup points by using the attribute @ref. Here is an example of the legend of the seal in [fig. 1] with only the markup relevant for the indices:

```
<div type="textpart" subtype="face" n="rev" rend="linear">
  <ab>
    <lg type="legendsCases" ref="legendsCases.xml#Dat">
      <l>
        <lb n="1"/>
        +
        <rs type="invocation" ref="invocation.xml#Κύριε" rend="linear">Κύριε
βοήθει</rs>
        <lb n="2"/>
        <persName type="unattested" ref="prosopography.xml#Μιχαήλ_1">
          <name>Μιχαήλ</name>
        </persName>
        <lb n="3"/>
        <rs type="dignity" ref="dignities.xml#βεστάρχης">βεστάρχης</rs>
        <lb n="4"/>
        και
        <rs type="officeCivil" ref="officeCivil.xml#οικονόμος_τῆς_Νέας">
          οικονό
        <lb n="5" break="no"/>
        μω τῆς
        <placeName ref="geography.xml#Νέα">Νέ
        <lb n="6" break="no"/>
          ας</placeName>
        </rs>
      </l>
    </lg>
  </ab>
</div>
```

The Authority Lists will be shared among all SigiDoc-based projects, which will have the responsibility of supplementing them with new entries arising from their own materials.

The approach used for indices is part of a broader objective of simplified data searchability, on the basis of developing a standard: creating a set of common and shared rules allowing for proper interoperability. Such interoperability will be realised primarily through a centralised search interface, which will allow for a virtual unification of all the corpora encoded in SigiDoc, thus going beyond the indices themselves and single search forms of each EFES corpus. The functionality of this interface will be based on the shared application of the principles currently employed in the creation of indices and search forms for individual projects. The unified search interface is not yet available and represents the main goal of the next round of SigiDoc's development, currently seeking funding.

If appropriate indices and search forms are effective with large amounts of data coming from large quantities of seals, the meaning of each seal needs to be fully explained in its commentary. In printed sigillographic editions, commentaries greatly differ in structure among publications, especially when it comes to a proper historical analysis connecting the seal to people, sources, and events related to the broader context of Byzantine history. SigiDoc gives its users the freedom to choose the approach they judge best for their data. The commentary takes the form of a separate <div>, organised in several <p>s containing also bibliographical references, automatically

generated by EFES on the basis of a TEI bibliographical list; bibliography, too, will be shared and available to all SigiDoc-based projects.

As it is also designed for the digitally enhanced edition of material already published in print, after a long and lively debate we decided that SigiDoc's template should include a <div> specifically designed for footnotes. Footnotes play a major role in scholarly publications in the Humanities and represent more than a place to store bibliographical references: they show the sources of a statement written in the main text, they offer a space for further argumentation and demonstration, and offer a chance to discuss other publications without burdening the main text. In EpiDoc-based projects this feature is not explored, and the rule is to have short references for the bibliographical apparatus or written in brackets inside the commentary. However, if one wants faithfully to transpose a printed publication into a digital form, one should find a place for footnotes:⁵⁴ the amount of information they convey might be too rich to be incorporated into the main text without jeopardising its legibility, as has been shown clearly by the experience in progress of transposing a journal article into digital form with SigiDoc (Sopracasa, Prigent 2017).

Furthermore, thanks to the possibilities offered by EFES, the corpora encoded in SigiDoc will be multilingual by default. The accessibility of the data coming from seals will thereby be increased, reaching non-specialists, too: the user will find a multilingual version of the frame of the standard webpage, including the field names structuring the data, as well as the indices; however, the data themselves (including the text of the legend) and the plain text will have to be manually translated.

4 Conclusions

By means of the new encoding standard SigiDoc, the digital enhancement of a discipline in the Humanities, Byzantine sigillography, has finally been reached: it manifests itself through searchability, interoperability, and accessibility of data. SigiDoc was not born out of nothing and is not creating a digital approach anew: we have assessed already existing and well-supported standards to build upon and customise as needed. This choice allows in turn for interoperability with adjacent disciplines, e.g. epigraphy, papyrology etc., giving us the opportunity for comprehensive analysis of inscribed material in a larger context.

The new standard will express its full potential in ongoing editions of large amounts of data, such as sigillographic corpora. For

54 By faithfulness, we do not mean that the webpage with a seal's edition should be a replica of the printed one, but that its content should not suffer any loss.

further development, however, it is crucial to release the project as soon as possible and let interested users experiment with it. We now have the first SigiDoc-based funded project, soon to be undertaken at the University of Oxford, on a collection of Sicilian *signacula*; this project provides a concrete use-case of a small corpus, and will produce more documentation, and the possibility for student training and contributions.⁵⁵ Testing on different material leads to improvements as the standard grows over time.⁵⁶ Moreover, thanks to its interaction with EpiDoc and EFES, SigiDoc allows the editors both to create accurate and reliable data and to take care of, and have control of, specific aspects of the online publication.

In light of what has been analysed in this paper, we argue that widespread use of SigiDoc will enable the digital enhancement of Byzantine sigillography, thus permitting not only the conversion of analogue information into digital form, but also an extensive exploration of the possibilities provided by the Digital Humanities for the enhancement of the entire editorial process.

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55 The title of the project is *From Sicilian Signacula to Student Epigraphic Editions: Building Sustainable Epigraphic Text Publishing for Oxford* and will be led by Prof. Jonathan Prag.

56 See e.g. Werning 2016 and the Open Access Wiki on the adaptation of TEI-XML in Egyptology and Coptic Studies edited by Daniel A. Werning: https://wikis.hu-berlin.de/teiegyptology/Main_Page.

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