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Ethio-SPaRe

Cultural Heritage of Christian Ethiopia:

Salvation, Preservation and Research

Seventh and Eighth Mission

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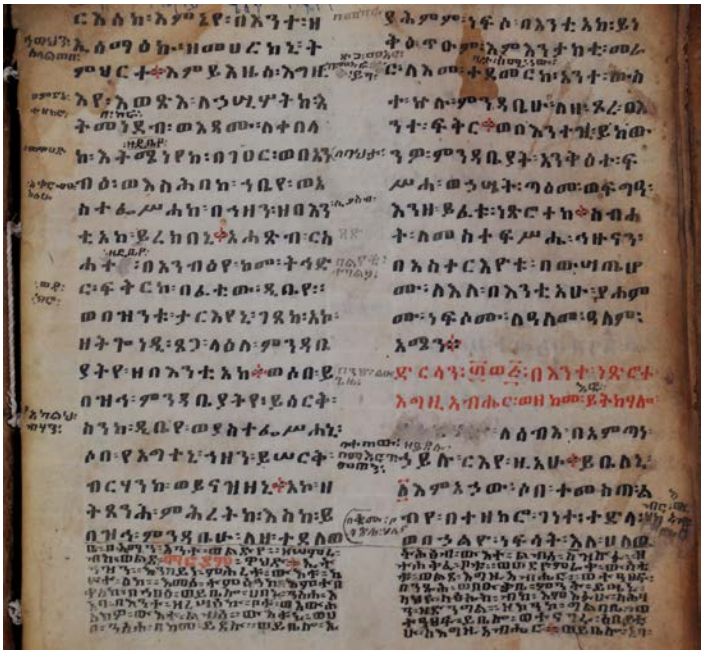
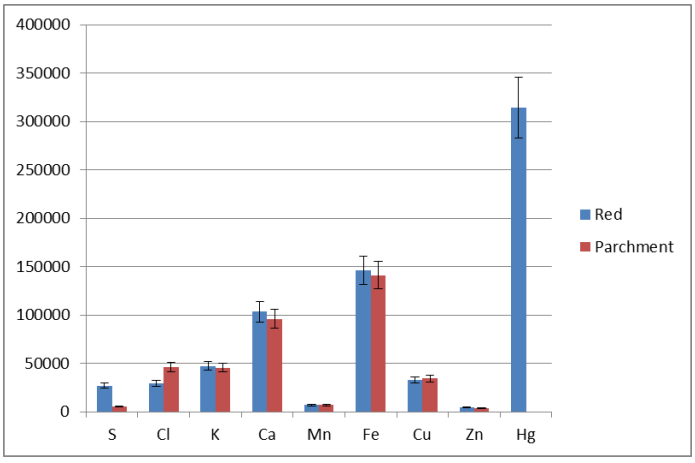
Report Part 2

(by Denis Nosnitsin, PI)





Hamburg University
2014

Ethio-SPaRe Eighth Field Mission (June 2014)
Public Report. Part 2. Instrumental analysis of manuscripts

Introduction

The final stage of the Ethio-SPaRe manuscript conservation program[1] included also some trials in material studies of selected manuscripts which were carried out on 7-9 June 2014 at the site of ʿUra Mäsqäl (Gulo Mäkäda). During these days, the team of the project Ethio-SPaRe was composed of the PI and the regular research assistants S. Hummel, Dr. V. Pisani, S. Dege-Müller and Dr. S. Ancel, the manuscript conservators M. Di Bella (Palermo, Italy), Dr. N. Sarris and N. Pantazidou (Technical School of Conservation, Zakynthos, Greece), and D. Domec (PhD candidate, University of Essex)[2], as well invited scholars: philologists Prof. A. Bausi and Dr. A.

[1] The work of the project's conservators' team will be a subject of a separate report which is now in preparation.

[2] As it was the case during previous missions, the representatives of the Tigray Tourism and Culture Agency, Orthodox Church and local communities were involved and assisted the project team. I express my gratitude to Käbbädä ʾAmarä (project coordinator), Mäsärät Haylä Səllase (field coordinator), Yirga ʾAsäffa (field assistant)

Brita (Hamburg University), and the specialist in material studies Dr. I. Rabin (BAM; Federal Institute for Material Research and Testing, Berlin/ Center for the Studies of Manuscript Culture, Hamburg)[3].

As it is commonly known, the analysis of inks is one of the most significant issues in the study of any book culture in general and each single manuscript in particular. As far as Ethiopian manuscript-making tradition is concerned, it has been generally assumed that historical black inks produced in Ethiopia and used by the local scribes belong to the type of the so-called carbon inks[4]. At the first glance, it seems to be correct and does not contradict the general experience[5]. However, after dealing with many manuscripts during the Ethio-SPaRe field missions, it became clear that the colour of the inks, both black and red, show a significant number of deviations. In the majority of the manuscripts which the project team recorded, the black ink is indeed of solid (deep) black colour, and shows good quality: it has a little shiny appearance; it does not flake off and does not fade away even in manuscripts of significant age. But in a certain number of manuscripts the ink is not really black, but tends to brown or grey of various tones. In some manuscripts, differences in the colour of inks are clearly visible within the main text, or between the ink of the main text and the ink of the commentary, or musical notation signs, or additional texts and notes, or legends of the miniatures etc.[6] The reasons for that might be not only

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from the TCTA; Fəṣṣum Gäbru, the representative of the Eastern Təgray Diocese; *mälakä sälam* Bərhanä Kidanä Maryam, the head of the Church office of Gulo Mäḳäda *wäräda*.

[3] I am grateful to Dr. I. Rabin for her advices and help in organizing the scientific manuscript research in frames of Ethio-SPaRe and readiness to join the team for the field mission in Ethiopia. She provided all diagrams and analytical conclusions concerning the material studies in the text below, and was always available for discussing any practical and theoretical aspect of the work.

[4] The literature on inks in various manuscript cultures is extensive. As to the main types, Agati 2009: 267-271 indicates the carbon ink as the most ancient type of inks, even though less adopted to writing on parchment than another main type, the iron-gall inks (obviously, the Ethiopian tradition provides an argument for the contrary; also Jewish oriental tradition has many books written with carbon inks), cp. also Déroche et al 2006:113-115 for the Middle East Arabic manuscript traditions (cp. Clemens – Graham 2007:19-20). Déroche et al 2006:111-119 indicates three main types: carbon inks, iron-gall inks, and "compound inks" composed of (the ingredients of) the first two types. Gacek 2009:132-134 summarizes the main ink types as follows: carbon inks, iron-gall inks, mixed or compound inks ("consist of ingredients used traditionally in both carbon and iron-gall inks"), and the so-called incomplete inks (see the definition in Zerdoun Bat-Yehouda 1983:14: "Il y a enfin ce que nous appellerons les encres incompletes qui, normalement, devraient entrer dans l'une ou l'autre des catégories principales s'il ne leur manquait pour cela ... un des éléments essentiels"). From here onward, the inks prepared on the basis of tanning substances extracted from plants will be referred to as "plant ink", approximately corresponding to "incomplete inks" and finding parallels in other manuscript traditions elsewhere, cp., e.g., once widely used "Theophilus ink" (or thorn ink, "Dornrindentinte" / "Dornentinte").

[5] It is commonly assumed that preparation of the ink is the work of the scribe. Sergew Hable Selassie 1981:14-15 provides six recipes for black inks, all on the basis of carbonized plants and soot; cp. also a detailed description of the preparation of black ink according to a recipe in Godet 1980-82; nine recipes are provided in Fäqadä Śəllase Täfärra 202 A.M.:137-158; a few more recipes are collected in Tornerie 2006.

[6] The differences are hardly signaled in the catalogues of Ethiopian manuscript. Sergew Hable Selassie 1981:14 mentions that the colour of the black ink has two varieties, "charcoal black" and "greenish black", the first being "for serious works" and the second for "magical prayers", and that the colour "depends on the composition of ingredients and the way of preparation". Several authors stress that the known recipes (circulated orally until they were recorded by scholars) specify the ingredients, but not specify exactly their quantities (which is done by each scribe according to personal skills and experience) which inevitably results in significant diversity. Moreover,

varying storage conditions, extensive use, degradation of materials, but also original characteristics of the inks themselves. Obviously, systematic recording and analysis of the inks with scientific methods can be helpful for solving a number of research issues. Assuming that the Ethiopian inks might show a greater diversity than formerly thought, the team of the project has been looking for simple and economic non-destructive scientific methods for the preliminary ink classification which can be implemented in conditions of the field research[7].

After consultation with a specialist in manuscript material research[8], mainly two techniques – reflectography and X-ray spectroscopy – came in question for the field conditions, and two relevant devices were selected, each with both strong points and limitations. For conducting simple reflectographic measurements, a portable digital microscope was proposed which can make pictures in different modes of light (VIS, UV, NIR). Starting from the fifth mission (November 2012), the project team extensively employed the microscope Dinolite Pro2 AD413T-I2V for quick preliminary ink analysis in the field, and it was helpful for also catching physical details of both writing and binding structure. Various types of inks react differently in NIR light, therefore the photos made with the microscope permit a rough classification of the inks in manuscripts[9]. Besides, it turned out that the images can highlight the manner in which the ink is distributed on parchment, showing subtle details which may potentially be helpful in enquiring of the historical writing tools and writing techniques[10]. It was not easy to select the books and the features *in situ*, within a very short time and in rough conditions; but the major limitation of the method is that the pictures do not tell us anything about the actual chemical composition of inks, even though they do permit us to clearly assign the inks (especially pure ones) to two major types, carbon or plant inks, and capture the presence of the mixed inks. The interpretation of the images is not easy and requires some skills. The usual

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Tournerie 1986:93-96 presents a few recipes for brown dyes or inks (the exact function is not always clearly specified, but at least some of them were certainly used as inks) which seems to be fitting into the category of "plant ink" (see above).

[7] Despite the fact that the scientific techniques for study of writing materials have been developing and improving, and quickly get wide recognition (cp. Rabin 2012), not many attempts to apply them on the Ethiopian material have been done so far. One should mention, for instance, the works described in Wion 2004 (for murals), in Richardin et al 2006 (for protective scrolls), in a communication by S. Delamarter "X-Ray spectroscopy and a Fourier Transform-infrared analysis of Ethiopian Inks" on results of an ink analysis carried out by a group of scientists (Tami Lasseter-Clare, Natasja Swartz, Aaron Ray, Department of Chemistry, Portland State University) made on the workshop of COMST in Hamburg, July 2010 (see Bausi 2014: 50, no. 38; http://www1.uni-hamburg.de/COMST/meetings.html).

[8] Dr. I. Rabin (BAM; Federal Institute for Material Research and Testing, Berlin / Center for the Studies of Manuscript Culture, Hamburg); the first contacts and exchange of information took place within the framework of Comparative Oriental Manuscript Studies (COMSt) network, http://www1.uni-hamburg.de/COMST, which also played a big role in further elaboration of research methodology.

[9] Pure carbon inks (dispersion of carbon particles) remain unchanged in NIR light, iron-gall inks partly lose their visibility and intensity, mixed inks partly lose their visibility and intensity as well, though the presence of the insoluble carbon component will be always noticeable, and plant ink becomes completely invisible in NIR light (cp. Rabin et al 2012:29; and personal communication).

[10] The differences can be visible also on pictures of high resolution, but the microscope helps to confirm the optical impression.

competence of a manuscript researcher with philological background is not really sufficient, and consulting a specialist in material analysis is necessary.

Another option under consideration was performing spectrometric measurements in the field. In the recent years, spectrography instruments determining chemical components of the materials and objects have been quickly developing. The method is applied also to materials used for production of the cultural heritage and, specifically, for manuscripts (inks, pigments, parchment). Most of such attempts were conducted in good conditions or just in laboratories. In the conditions of field research in Ethiopia, the use of complex or heavy, though highly effective micro-XRF devices is not possible. Thus Dr. I. Rabin opted for the X-ray fluorescence spectrometer Tracer III-SD. It permits establishing elemental composition of the materials tested and their relative amount. The weak point is that the measurements are still rough; the use of the device on manuscripts presents a few technical challenges[11]. On the whole, esp. in combination with the digital microscope, the Tracer III-SD turned out to be a reasonable choice.

[11] Tracer has a low spatial resolution as compared to that of the μ-XRF spectrometers. Its large (8 mm^2) measurement spot usually exceeds the inked area. In addition, the primary X-Ray beam is not very intense leading to long signal collection times.

1. Analysis of manuscripts from ʿUra Mäsqäl

Most of the spectrometric measurements were conducted in the collection of the church of ʿUra Mäsqäl which accommodates a significant number of manuscripts dating to various periods[12]. All in all, measurements were done on 11 manuscripts, in the first line those items which were treated by the conservators. Besides, general aims of the trials were to enhance our knowledge of the local manuscript culture, to search through multidisciplinary work for new ways of synthetic approach to the study of both individual manuscripts (e.g., by means of incorporation of the results into regular manuscript descriptions) and entire collections, and, of course, to define the corpus of manuscripts potentially interesting for future research. Below are two short reports concerning the results of the reflectography and spectroscopy conducted on two selected manuscripts from ʿUra Mäsqäl, preceded in each case by a concise description of the item in question. The reports are followed by brief reflectography evaluations of the inks of seven manuscripts, of various age and provenance, conducted on the basis of the Dinolite images.

1.1. Octateuch UM-040.

Content:

I) Genesis" (fols. 5ra-42vb), incomplete (the beginning missing);
II) "Exodus" (fols. 43ra-74va)
III) "Leviticus" (fols. 74vb-100ra)
IV) "Numbers" (fols. 100rb-138va)
V) "Deuteronomy" (fols. 139ra-170va)
VI) "Joshua" (fols. 170vb-194vb)
VII) "Judges" (fols. 194vb-216ra)
VIII) "Ruth" (fols. 216rb-216vb), incomplete (the end missing).

Physical description:

Dimensions. 29 width x 41 height x 11 thickness (cm).
217 folia in 28 quires.
Binding[13]. Two wooden boards covered with reddish-brown leather cover, for the most part missing; two pairs of sewing stations. Some quires are reinforced by parchment guards.
Pricking and ruling. Ruling pattern: 1A-1A-1A1A/0-0/0-0/J[14]. Primary pricks for vertical ruled lines are set at the upper and bottom horizontal ruled lines; pricks for the horizontal ruled

[12] The biggest part of the collection was recorded by Ethio-SPaRe during its first field mission, as 45 "registration units", which must encompass at least 55 manuscripts of different age (see Nosnitsin 2013:3-8). So far, the work of the team has resulted in 36 descriptions.
[13] The Ms. was probably re-sewn and rebound, more than one time. Half of the front board is missing. Leather cover is torn off, only turn-ins are preserved. Most of the leaves are badly damaged by water and fire, esp. in the upper part, with loss of some text.
[14] After the system proposed in Muzerelle 1999.

lines are placed in the margins. The upper written line is placed under the upper ruled line, as is the case of many pre-16th-cent. manuscripts.

Ink. The inks of the main text are not black, but show light brown colour, with some variations. The colour of the rubrics is not pure red (vivid red), but vermillion.

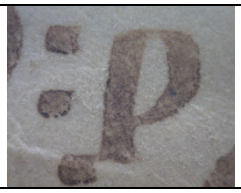
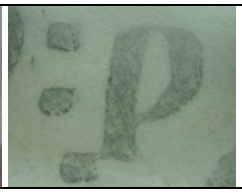
Palaeographical features. Quite a number of codicological and palaeographical discontinuities are visible in the codex, but it is not easy to exactly define and evaluate them. Several scribes must have participated in writing (cp. fig. 1 [fol. 18ra, Gen. 21], fig. 2 [fol. 93ra, Lev. 21], fig. 3 [fol. 101ra, Num. 1]). The letters are ca. 5mm in height, the line accommodates ca. 16-18 signs. Ancient features of the script are visible throughout the manuscript, though expressed to varying degrees, according to various hands: *ṭ* (ጥ) with lateral strokes ("legs") nearly reaching the "base line"; *s* (ሰ) with the 6th-order marker constructed of a vertical stroke and a perpendicular horizontal stroke; *ʿa* (ዓ) with the vowel marker set in the middle of the letter's body, reaching the "base line", etc. At least one of the hands (fig. 1) appears somewhat similar to that of Ms. Vatican Library, éthiop. 263 (fig. 4). On the whole, UM-040 seems to be comparable in age with Ms. éthiop. 263[15].

Dating: possibly ca. 1300-1350?

Additiones and varia. The Ms. does not contain marginal notes. However, its first quire encompasses two fragments of two old manuscripts, used as guard leaves, of two worn folia each, with the writings of comparable or perhaps somewhat older age[16]. Many folia of the main text bear (sometimes extensive) corrections, in main (?) and later secondary hands, made mostly over erasures or added interlineally.

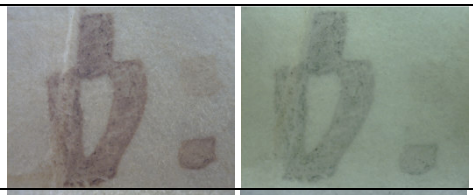
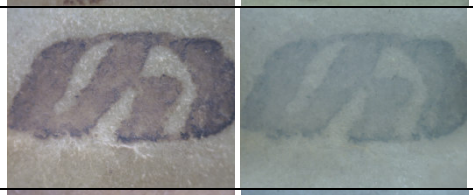
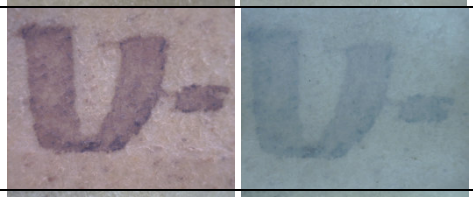
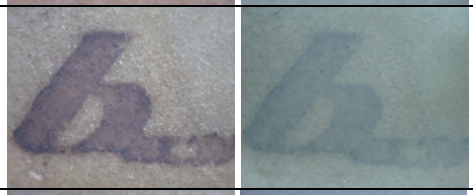
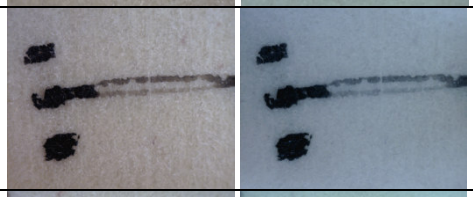
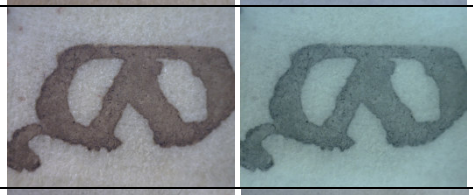
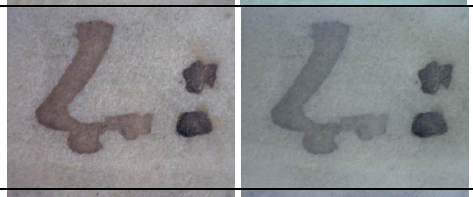
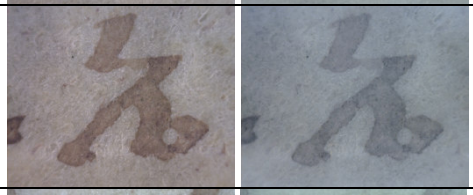
1.1.1. Reflectography

All in all, some 30 probes have been done at various locations in the manuscripts.

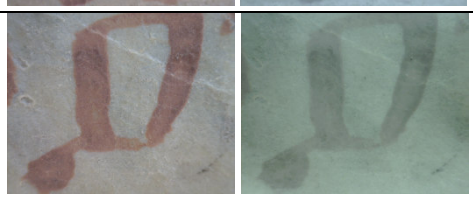
UM-040, location	*Commentary*	*Visible light*	*NIR light*
1. UM-040, fol. 1vb, l.16	ጵ, leaves from a different codex (s. above)		
2. UM-040, fol. 1vb, l.17	ፇ		

[15] Ms. Vatican Library Aeth. 263 (van Lanschoot 1962:465, plate I) contains the Book of Isaiah, Ascension of Isaiah and Book of Daniel; according to the catalogue, the name of the scribe might be "Ṣäga Mättä" (Ṣäga Mäṭa[ʿ]?). On the dating see Uhlig 1988:125-126 (and index); see also the note on problematic estimation of palaeographic features because of "irregular and unbalanced" appearance of the script, for which however some explanations have been proposed (ibid. 127).

[16] The first fragment contains a part of the "Homily by John Chrysostom on Christ when He says 'If it be possible, let this chalice pass'"; the second, being probably a fragment of an Octateuch manuscript, contains Gen. 41:31-43:5 (I owe these indications to Prof. A. Bausi).

3. UM-040, fol. 1vb, l.22	ዕ	
4. UM-040, fol. 3vb, l.26	ሙ, leaves from a different codex (s. above)	
5. UM-040, fol. 3vb, l.20	ሁ	
6. UM-040, fol. 3vb, l.26	ፌ	
7. UM-040, fol. 200ra, inner margin	paragraph sign (added later, by the correction hand, s. below)	
8. UM-040, fol. 200rb, l.3	ም, main hand	
9. UM-040, Fol. 200rb, l.3	ሩ	
10. UM-040, fol. 200rb, l.3	ኤ	
11. UM-040, fol. 200rb, l.11	ቤ, correction written over an erasure, in a later (late 14th/early 15th?) hand[17]	

[17] It shows palaeographic features resembling the main hand of Ms. UM-027, s. below.

12. UM-040, fol. 200rb, l.11	ፙ፡	
13. UM-040, fol. 200rb, l.11	ይ	
14. UM-040, fol. 202ra, l.1	እ, main hand	
15. UM-040, fol. 202ra, l.1	ዝ	
16. UM-040, fol. 202ra, l.1	ስ	
17. UM-040, fol. 202ra, inner margin	paragraph sign, main hand	
18. UM-040, fol. 43ra, l.2	እ red, the incipit of Exodus	
19. UM-040, fol. 43ra, l.6	ዖ	

Reflectography shows the change in opacity, i.e. in all cases (except pics. 7, 11-13, the correction hand) the inks lose the colour and intensity in NIR light, therefore two pure types (plant and carbon) can be excluded. In the case of the ink from fol. 3v the change is more pronounced. Given the fact that the black inks become completely transparent in neither case, we conclude that they are either 1) a mixture of plant inks with carbon inks or 2) plant inks cooked in such a way that the carbon component

arises during the cooking (e.g. the ingredients are roasted). The inks seem to be distinct from each other but most probably prepared according to similar recipes. As to the ink of the correction, it retains the same colour in the visible and NIR regions, the fact indicating that we are dealing with the inks of purely carbon type. The red ink (pics. 18-19) do not become transparent in NIR light, through partly loses intensity, that excluding plant origin and indicating the presence of an insoluble pigment.

The pictures made with Dinolite microscope render visible some peculiarities of the ink distribution on the parchment. The (vertical) strokes which build the letters of the correction (figs. 11-13) show thick nontransparent layer of the ink, with the edges of almost the same density as the inner area of the strokes (from here onward, the ink distribution of this type will be referred to as "type 1")[18]. The strokes of the main hand demonstrate somewhat different picture, slight concentration of the ink on the edges and more sparse distribution in the inner area (in the following called "type 2").

1.1.2. Spectroscopy

Spectrometry was carried out on 11 locations in UM-040, mostly the same folia upon which the Dinolite was applied.

Two locations were measured on the added fol. 1 and fol. 3, resp., each time one measure for ink and one for parchment (diagram 1a). In the text block, seven locations were measured: fol. 200rb main hand; fol. 200rb parchment in the margin (two probes); fol. 200rb main hand and correction; fol. 202ra main hand and parchment (diagram 1b).

The inks on fol. 1v and 3v differ in individual amounts of the elements Ca, Fe, and K (see diagram 1a)[19]. The ink on fol. 3v has a higher content of Ca, Fe, and K as compared to fol. 1, whereas the ink on fol. 1 hardly differs from the underlying parchment. It is noteworthy that the amount of iron in the inks doesn't exceed considerably that found in the parchment. Therefore, a recipe of iron-based inks should be excluded.

[18] And distributed more sparsely on thin elements (horizontal lines) of the letters.

[19] Here and in the diagrams below, the elements' measurements are grouped distributed according to locations, but not grouped together as to show the entire range

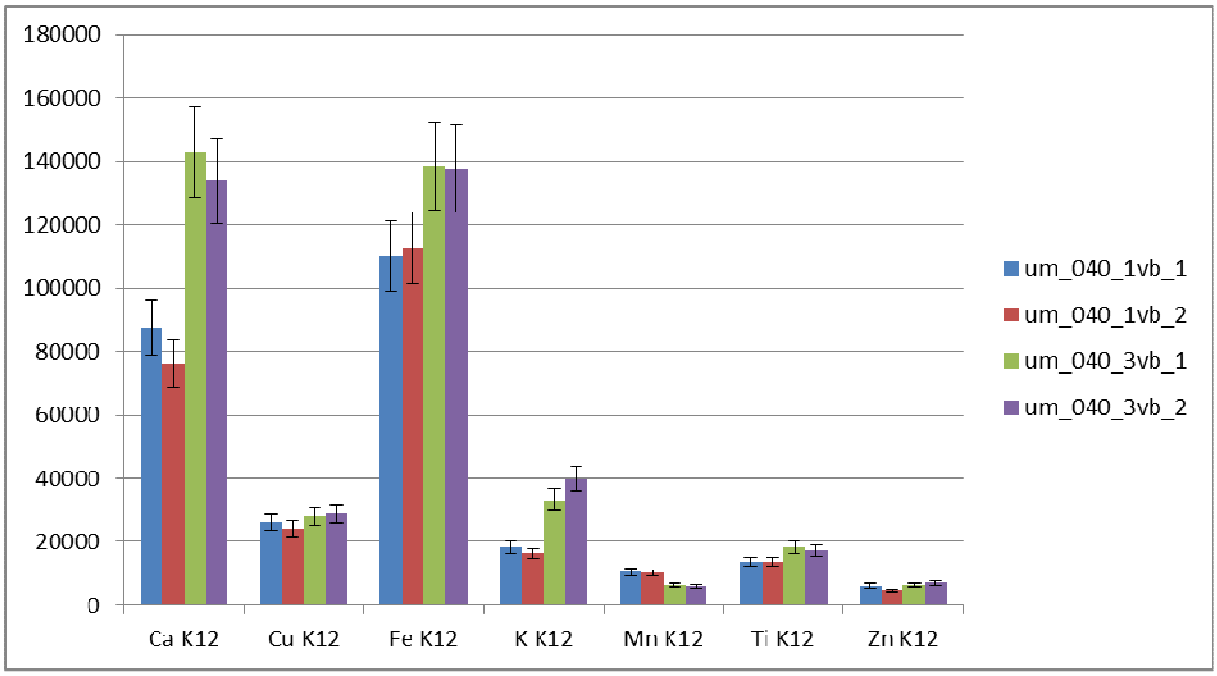


Diagram 1a.

As to the measurements in the text block (diagram 1b), the amount of iron is higher in the correction ink than in the ink of the main hand[20], but nothing indicates that the inks have an intentionally introduced iron component[21].

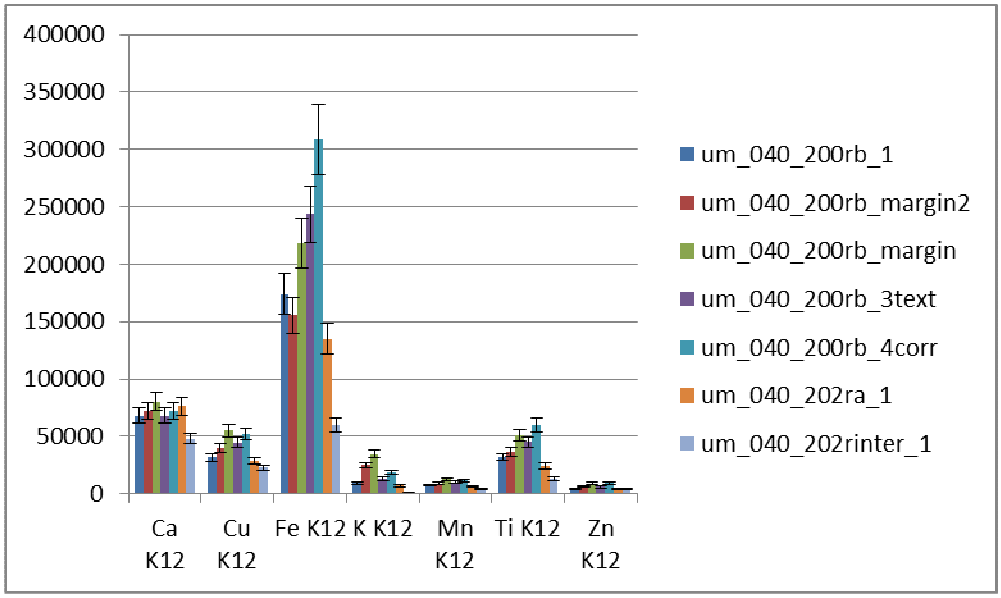


Diagram 1b.

[20] Cp. also the main hand of UM-027, diagram 2a.

[21] It would be interesting to analyse the inks of the aforementioned Ms. Vaticano etiopico 263, and compare the results.

1.2. Four Gospels UM-027.

Content:

I) Introduction
- Letter of Eusebius to Carpianus (fols. 2r [misplaced], 7r-7v),
- Canon tables (fols. 2v-5v)
- "Synopsis of Classes" (fols. 8ra-9ra)

II) Gospel of Matthew (fols. 9va-80vb)
- List of the "*tituli*" for the Gospel of Matthew (fols. 9va-10vb)
- "Gospel of Matthew" (fols. 11ra-80vb)

III) Gospel of Mark (fols. 81ra-125ra)
- List of the "*tituli*" for the Gospel of Mark (fols. 81ra-81vb)
- "Gospel of Mark" (fols. 83ra-125ra)

IV) Gospel of Luke (fols. 125rb-202va)
- List of the "*tituli*" for the Gospel of Luke (fols. 125rb-126vb)
- "Gospel of Luke" (fols. 128ra-202va)

V) Gospel of John (fols. 202vb-260vb)
- List of the "*tituli*" for the Gospel of John (fols. 202vb-203ra)
- "Gospel of John" (fols. 204ra-260vb)

Physical description:

Dimensions. 20 width x 29 height x 13 thickness (cm).

263 folia in 35 quires.

Binding[22]. Two wooden boards, covered with reddish-brown leather cover (for the most part missing); two pairs of sewing stations[23]. Most quires are reinforced with parchment guards.

Pricking and ruling. Ruling pattern: 1A-1A-1A1A/0-0/0-0/C. Primary pricks for vertical ruled lines are in the margins; text pricks were probably also placed in the margins, but in the current state of preservation they are not visible. The upper written line is placed under the ruling, as in many pre-16th-cent. manuscripts.

Inks: black and red.

Palaeographical features. The script is elegant and finely executed (fig. 5, fol. 78rb, Mt. 27:43-46); it shows a few ancient features, but not as many as one would expect because of the presumably old age of the manuscript (s. below). The letters are tall and slender (ca. 6-7 mm in height). The regular text line accommodates relatively small number of signs, ca. 8-10. This creates an impression of big and broadly

[22] Even though the manuscript is worn and shows traces of intensive use, it was found in relatively good condition. It appears, unfortunately, that some miniatures from the quire with prefatory text ("traditional introduction") had been taken out. The quires were "reinforced" with parchment guards which significantly strain the fragile binding of the big (35 quires) text block.

[23] The manuscript was re-sewn, probably more than one time. Half of the front board is missing. Leather cover is torn off, only turn-ins are preserved. Most of the leaves are badly damaged by water and fire, esp. in the upper part, with loss of some text.

spaced script, which is enhanced by the wide intercolumn margin (ca. 20mm). The word *ʾəgziʾabəḥer* ("God") is written as one unit. Letter *lo* (ለ) is written both with and without linking line; *ṭ* (ጥ) has lateral strokes ("legs") which are not conspicuously long and do not reach the "base line"; *ḫ*^{w}*ä* (ኈ) has the ancient shape (s. the picture below). The numerals show ancient features: ፻ (100) composed of two signs bound together, typically ancient shapes of ፴ (30) and ፮ (6). The chapter division follows the "old muster": Chi-Ro sign is used for chapter division, Ammonian section numbers are neatly executed, "*tituli*" are carefully written in red in the upper margin etc.

Dating: the second half of the 14th cent. (cp. below) cannot be excluded, but a somewhat later period – around the beginning of the 15th cent. – is somewhat more probable.

Additiones and varia. The codex contains up to 11 complex additional notes of various types, mentioning a few historical personalities, some of them well-known. Most of the notes are inventories of donated items. One of them (*additio* 2) might contain a hint to the manuscript's possible production date. It encompasses three short lists of donated items written one after another, and mentioning King Säyfä ʾArʿad (r. 1344-71), an unnamed "head of the monastery", and *mälake baḥər* Bəlän Sägäda, resp.[24]. A few other notes refer to a local prominent ecclesiastic called Tänśəʾa Krəstos, from the time of King Bäʾədä Maryam (r. 1468-78). One note refers to King Ləbnä Dəngəl (r. 1508-40); the latest date referred to in the *additiones* is 306 year of mercy, the year of Mark, which may be 1654 A.D.[25]

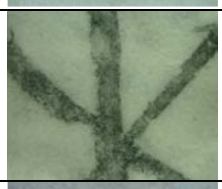
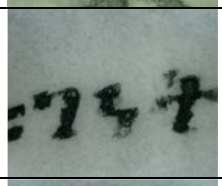
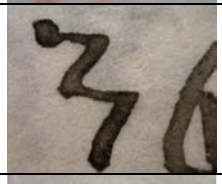
1.2.1. Reflectography

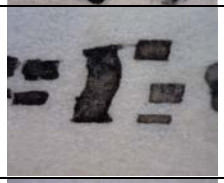
All in all, 31 probes have been done at various locations in the manuscript (both black and red inks of the main hand, miniatures, hands of the *additiones*). Here below are some of them.

UM-027	*Commentary*	*Visible light*	*NIR light*
1. UM-027, fol. 1r, l.1	ባ main hand (?), red		

[24] Bəlän Sägäda seems to be a nobleman who lived in the second half of the 14th cent., North Ethiopia (see EAe I, 524a, G. Lusini). The document is written in a fine hand, but it is doubtful if the note (potentially important for dating of the manuscript) really dates back to the time of Säyfä ʾArʿad. Another possible explanation is that this is a short "cartulary" summarizing the content of other documents which did not survive (like the case described in Nosnitsin 2013a), posterior to the time of Säyfä ʾArʿad. Paleographically, the script of the *additio* is rather datable to the late 14th or early 15th cent.

[25] A comparable note, written in a similar hand, had been registered in Ms. MY-008, fol. 10rb: በ፳፻፭ ወኀ፡ አመተ፡፡ ምሕረት፡ በ፫፻ወኀ፡ አመተ፡ ምሕረት፡ መጽአ፡ ርሀብ፡ ለዕለ፡ ኵሉ፡ ም[ድ]ር (left un-deciphered in Nosnitsin 2011:26 and no. 14), but at least the second date, 306 year of mercy, apparently refers to 1654 A.D.

2. UM-027, fol. 1r, l. 2	፡ሞ main hand		
3. UM-027, fol. 1r	Chi-Ro sign		
6. UM-027, fol. 6r	ነት, legend		
8. UM-027, fol. 11rb, l. 3	ኦ, main hand, red		
9. UM-027, fol. 11rb, l. 2	ደ, main hand		
12. UM-027, fol. 17rb, intercolumn	፮, numeral 6, red		
14. UM-027, fol. 82vb	ንፉ, note issued by Tänśəʾa Krəstos		
15. UM-027, fol. 249rb, l. 9	ኦ, main hand		
16. UM-027, fol. 249rb	Intercolumn, middle of the Chi-Ro sign, red		
17. UM-027, fol. 263ra, l. 4	ሙ, main hand		

22. UM-027, fol. 82ra	ⲏ, note by Tänśəʔa Krəstos, the time of King Bäʔəda Maryam		
24. UM-027, fol. 82va, l. 5	ⲣ̄, document mentioning King Säyfä ʔArᶜad		
29. UM-027, fol. 127vb	ⲙ, document in a later (17th cent.?) hand		
30. UM-027, fol. 260vb, l. 13	ⲯ, donation note, a secondary (15th-cent.?) hand		
31. UM-027, fol. 263ra, l. 1	ⲧ, commemoration note on Tänśəʔa Krəstos		
32. UM-027, fol. 263ra, l. 16	ⲃ̄, inventory		

All black inks remain perfectly visible in NIR light, do not change intensity and invariably belong to the carbon type (pics. 1, 8, 12). Red ink remains poorly visible, but do not disappear completely (pics. 1, 8, 12, 16), which indicates the presence of pigment (also see below, diagram 2b).

Thick nontransparent layers of ink, in particular of the vertical strokes and extremities of the letters ("type 1"), are visible on the most samples, with the exception of pics. 3 and 16[26], possibly 24, and certainly 14, which shows a thinner ink layer with slight concentration on the edges ("type 2").

1.2.2. Spectroscopy

2a) Spectroscopic measurements were carried out on 13 locations. Here below are the results for 9 of them, fol. 2r parchment; fol. 2r, l.3 black ink; fol. 2r, l.4 black ink; fol. 17 parchment and two probes of black inks; fol. 263ra: parchment, ink of commemoration note, ink of inventory.

[26] Chi-Ro signs appear to have been written with writing instruments different from the pen used for the main text.

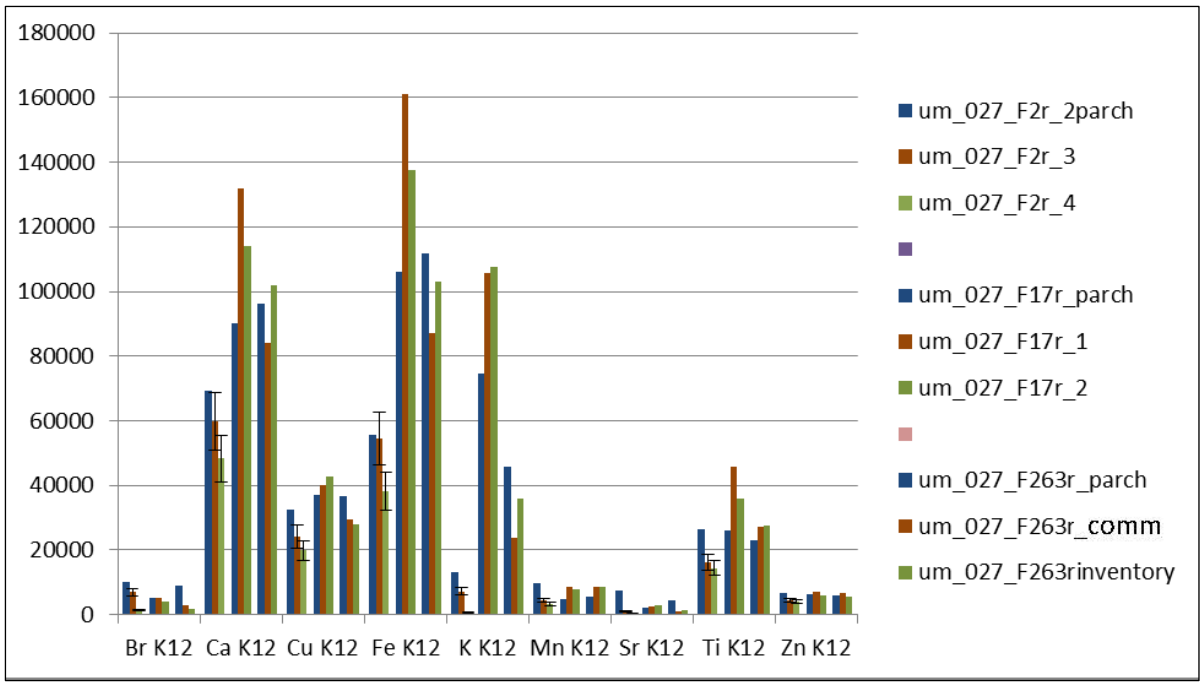


Diagram 2a.

The black inks, though of various compositions, are invariably of the carbon type; the amount of iron is high in the main hand; it seems to be comparable to that in the correction hand of UM-040 (see above, diagram 1b).

2b) One probe was made for the red ink of the regularly rubricated elements, fol. 249, chapter title in the upper margin. Diagram 2b shows elements detected in the red ink as compared to those detected in the parchment.

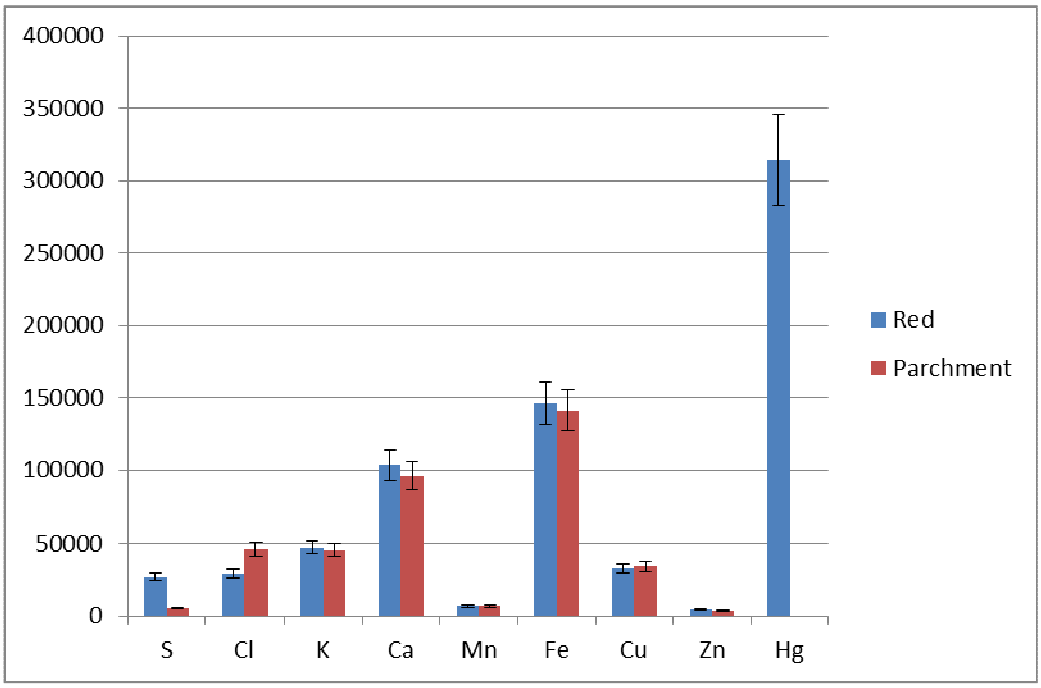


Diagram 2b.

Very intense peak corresponding to mercury (Hg) appears in the spectrum corresponding to the red ink with no counterpart in the spectrum of the parchment. Element sulfur (S) displays enhanced intensity in the XRF spectrum of the red ink as compared to that of the underlying parchment. Therefore, the red ink consists of cinnabar, HgS.

2. Reflectography of selected manuscripts

For the moment, it appears that carbon inks were used in the vast majority of the investigated manuscripts, even though a large variety of deviations in chemical composition will certainly come to light at a more detailed analysis. However, some cases were identified where the results of reflectography are indicative of the ink which may be different from the common carbon type[27]. Besides, as it was indicated above on examples of UN-040 and UM-027, some differences are discernible in the way of the physical distribution of the ink within the elements of the letters.

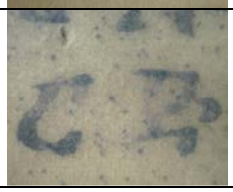
2.1. DGQ-002, "Miracles of Mary" (Däbri Däbrä Zakaryas Giyorgis).

This sizable volume containing the Vita and Miracles of St. George is datable to the second half of the 17th/18th cent.; it includes four much older leaves originating from two different manuscripts, used as guard leaves ("fragment a", pics. 1-3 and "fragment b", pics. 4-6)[28]. Below are some of the probes taken from both of them.

DGQ-002	*Commentary*	*Visible light*	*NIR light*
1. DGQ-002, fol. 2ra, l.12	ጸ, here and below black ink		
2. DQG-002, fol. 3rb, l. 15	ወ·		

[27] For the moment, the available information is not enough, but there are hints that the situation might be different in the past (cp. Nosnitsin – Rabin 2014; on the use of the mixed ink, with the presence of iron-gall ink, in the manuscript of the so-called "Axumite canonical-liturgical collection" see Bausi 2014:60-64, and the next studies to appear), and one should keep in mind the fragmented, less unified nature of the Ethiopian bookmaking tradition, in which various local or old practices were not eliminated, but just kept at the periphery.

[28] The script of the text of "fragment a" is fully vocalized, that of "fragment b" show some deviations requiring more detailed study. The considerable age of both fragments (before mid-14th cent.?) was clear at the cursory palaeographic analysis. The "fragment a" belongs to the manuscript which was obviously dismantled, since another its fragment has been discovered in DQG-008, Four Gospels, recycled and used as guard (see Nosnitsin 2013:238, fig. 114b).

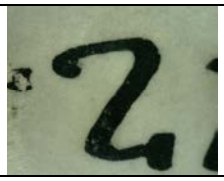
3. DQG-002, fol. 3rb, l.15	ወ		
4. DQG-002, fol. 4ra, l.3	በናት		
5. DQG-002, fol. 4rb, l.4	ድዎ		
6. DQG-002, fol. 4rb, l.10	ርድ		

The reaction of the inks to the NIR light is untypical to that of the common carbon ink. The ink of “fragment a” (pic. 1-3) seems to be mixed, with prevailing carbon component and admixture of another ink, iron-gall or plant. The ink of “fragment b” (pics. 4-6) appears to be of the same mixed type, but with a smaller amount of carbon.

The thickness and consistency of the ink layer is difficult to assess from the pictures, also due to the rather poor condition of the fragments. It looks like the ink distribution is of the “type 1”, with thick and even layers of inks.

2.2. TGM-003, “Undoing of Charms” (ʔAmba Tähula Mikaʔel).

TGM-003 is a 19th-cent. neatly produced codex which includes as guard leaves three folios of a much older Four Gospels manuscript, dating at least to the mid- or late 14th cent., or to a still earlier period (fig. 6)[29].

TGM-003	*Commentary*	*Visible light*	*NIR light*
1. TGM-003, fol. 1ra, l.1	ጊ		

[29] Jn. 7:8-47; the fragment shows some typical features of the “monumental” script.

2. TGM-003, fol. 1ra, l.2	ቢ		
2. TGM-003, fol. 2ra, l.23	፡		

The ink is definitely of the carbon type. The strokes show a thick and smooth ink layer, of almost the same consistency everywhere ("type 1").

2.3. RQG-012, "Praise of Mary" (Rubakusa Giyorgis)

RQG-012 is a damaged and worn manuscript, with many folia missing. The dating of the manuscript, tentatively proposed as the 15th century, is problematic since palaeographic features hardly produce a coherent picture; any other dating hints are missing[30].

RQG-012	*Commentary*	*Visible light*	*NIR light*
1. RQG-012, fol. 12rb, l. 3	ፙ		
2. RQG-012, fol. 48, l. 3	ኪ		
2. RQG-012, fol. 97ra	ሥ		

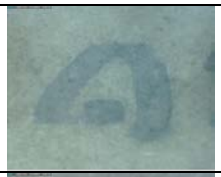
The ink is of the carbon type. The strokes show the distribution of the ink of "type 2", the layer of ink is relatively thin in the inner area of the strokes, with slight concentration on the edges[31].

[30] Nosnitsin 2013:405, 408 (fig. 62).

[31] This feature (visible only at a very close analysis of the script) strongly contrasts with elegant, firm and calligraphic shape of the letters.

2.4. UM-033, Fragment of an ancient antiphonary (?) (ʿUra Mäsqäl)

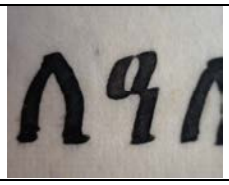
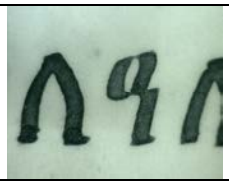
UM-033 is one leaf only, dating definitely to a period prior to the mid-14th century. The text shows a number of ancient palaeographic features and orthographic peculiarities.[32]

UM-003	*Commentary*	*Visible light*	*NIR light*
1. UM-003, fol. 1r, l.4	ል, black ink		
2. UM-003, fol. 1r, l.2	፪, red ink		
2. UM-003, fol. 1v, l.23	፦, black ink		

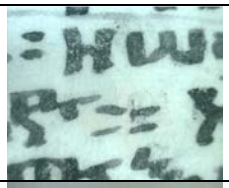
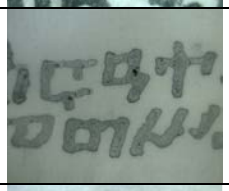
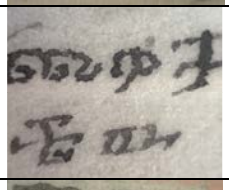
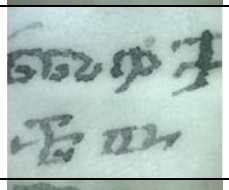
The black ink partly loses its intensity and visibility in NIR light, being possibly a kind of the carbon ink with admixture of plant ink. At a closer look, it is possible to see that small spots remain where the intensity does not change in NIR light, this possibly indicating that the ink was not mixed up well. The rubricated elements are of very peculiar lilac colour (pic. 2), which remains visible in NIR light, though loses intensity, indicating the presence of an insoluble pigment. The distribution of inks in the strokes seems to be even and mostly smooth, of "type 1".

2.5. MQMA-005, "Spiritual Elder" (Məngaś Maryam).

MQMA-005 is a complex, probably 17th-century manuscript, written by several scribes, showing traces of extensive and variable use (fig. 7), with margins densely filled with glosses, commentaries and one long hagiographic text[33].

MQMA-005	*Commentary*	*Visible light*	*NIR light*
1. MQMA-005, fol. 9rb	ለዓለ, main hand 1		

[32] More detailed study of the fragment is currently in progress (see Nosnitsin, in preparation).
[33] Written, unusually, in the bottom margin, see Nosnitsin 2013:234-235, fig. 111.

2. MQMA-005, fol. 15rb, bottom margin	፡ ዘሠ / ድ※ኢ, a secondary hand of the text in the bottom margin		
3. MQMA-005, fol. 9r, intercolumn	ሥርዓተ፡ መንግሥት, a secondary hand of the commentary		
4. MQMA-004,	ጨዋቻቼው, a secondary hand of the commentary		
5. MQMA-005, fol. 37rb, l. 8	ግበር / ሥር, a secondary hand of the commentary above, main hand 2 below		

All black inks are of the carbon type. The red ink (pics. 2, 5) is of plant type, as it disappears in NIR light. The fine main hand 1 and the hand which wrote text in the bottom margin show solid strokes of “type 1”; other hands (pics. 3-5), possibly including also the main hand 2 (pic. 5) show strokes of “type 2”.

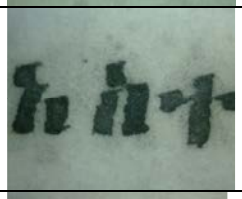
2.6. EMQ-008, Psalter and other texts (ʔƎnda Maryam Qorrar)

EMQ-008 is a 19th-cent. “pocket size” codex[34], with illuminations and a number of added texts.

EMQ-008	*Commentary*	*Visible light*	*NIR light*
1. EMQ-008, fol. 1v, l.2	ላክ, rubricator’s hand, incipit of an additional text[35].		
2. EMQ-008, fol. 1v, l.3	፡ ወ[በ], a secondary hand		

[34] Once it was in personal possession of a member of the local monastic community.

[35] The handwriting is crude, the text (an excerpt from the *Wəddase Maryam* “The Praise of Mary”) is written on an un-ruled leaf.

3. EMQ-008, fol. 1v, l.4	ረ, the same secondary hand as above		
4. EMQ-008, fol. 7r, l.3	አስተ, the main hand		
5. EMQ-008, fol. 124ra, l.16	እግዚ, the main hand[36]		

The black inks are of carbon type. Red ink becomes nearly completely invisible in NIR light, possibly being of plant origin. The main hand (pics. 4, 5) show strokes with a solid and thick layer of black ink, somewhat unevenly distributed, with uneven edges ("type 1"). The secondary hand (pics. 2-3) shows the stroke of "type 2", with thin layer of ink in the middle and slight concentration on the edges.

2.7. EMQ-060, Collection of miscellaneous texts (ʾƎnda Maryam Qorrar)

EMQ-060 is a 17th-cent. manuscript, containing, among others, also chants with rubricated musical notation signs.

EMQ-060	*Commentary*	*Visible light*	*NIR light*
1. EMQ-060, fol. 3ra, l.9	እ, red		
2. EMQ-060, fol. 3ra, l.10	ለካ		
2. EMQ-060, fol. 49ra, l.23	ምሕ		

[36] This probe is taken from that part of the Psalter which is laid out in two columns; here the scribe had to slightly reduce the width of the letters.

The black ink seems to be of the carbon type, and the strokes are of "type 2". The rubrics in the text are done with the ink of peculiar deep brown colour, which partly loses visibility in NIR light, but shows the presence of an insoluble pigment.

3. Conclusions

Examples of differences in the ink distribution as shown above raise the question of diversity in the historical writing techniques and the writing instruments. Today we know, in general, how Ethiopian scribes carry out the process of writing, and how the Ethiopian pen is produced[37]. We assume that, normally, the nib of the Ethiopian pen is split and invariably cut obliquely[38]. However, looking at the stroke forms as they appear in older manuscripts, one might wonder if there were variations according to the scripts, if other shapes of the pens could have been in use[39], and if some significant differences existed in the Ethiopian writing techniques[40]. For instance, it can be further enquired whether the classical Ethiopian pen as known today was really adopted and used for "type 2" stroke; or what kind of pen was convenient for the micro-script of the musical notation (*məlәkkәt*) – and in some cases the main script – of the Ethiopia chant manuscripts (such as, e.g., fig. 8, a 17th- cent. chant manuscript TRM-017). Systematic study of further material is necessary to better define these issues and questions.

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[37] Cp. Sergew Hable Selassie 1981:18, Mellors – Parsons 2002:11 with a good photo; Fäqadä Śəllase Täfärra 2002 A.M.:170-171 (an exceedingly difficult, not always clear passage).

[38] Corresponding to "angled nib", see Gacek 2009:41; see also two other types.

[39] Cp. shapes of the pen nib in the Middle East in Gacek 2009:41, and pens depicted in Déroche et al 2005:103-106; cp. also consideration in Agati 2009:262-283. Fäqadä Śəllase Täfärra 2002 A.M.:170-171 mentions that the pen nib should be selected according to the type to the envisaged script (a wider nib for bigger script, and a narrow for thinner script).

[40] A few scribes interviewed by the project members in various locations of East Təgray spoke of two ways of cutting the pen nib, *qum* and *säyf*. *Qum* has been described as the pen nib cut horizontally, corresponding to "square nib" (Gacek 2009:41), and *säyf* as the pen nib cut obliquely, corresponding to "angled" or "oblique" nib (Gacek 2009:41). These explanations are not exactly the same as those given for *qum* and *śäyyaf* in Mersha Alehegne 2011:157, 158. The interviewed scribes told that the *qum*-nib pen is out of use today. Ethiopian manuscript making is a long tradition, but today it exists in a strongly "reduced" form, since a large number of practices have been dropped, and the remaining ones influence each other more easily than in the past, and get "blurred". Many types of texts are not copied any longer. This underlines the necessity of not only collecting the contemporary practices, but also of trying to reconstruct their historical shapes using available manuscript materials.

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Plates (to Part 2)

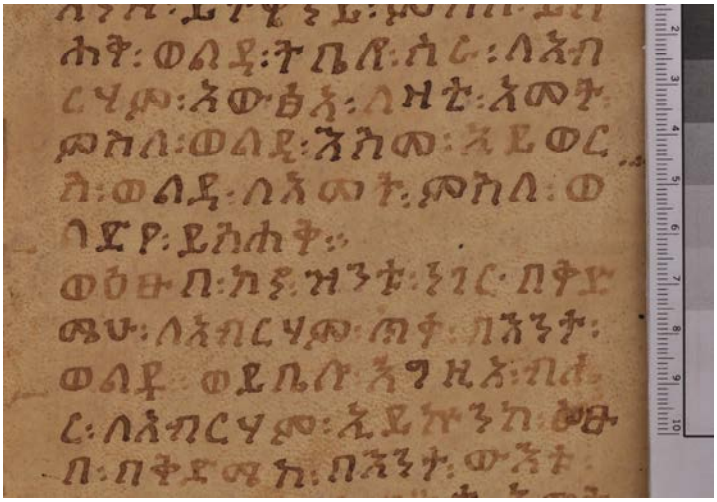

Fig. 1: Ms. UM-040, Octateuch, ʿUra Mäsqäl, fol. 18ra.

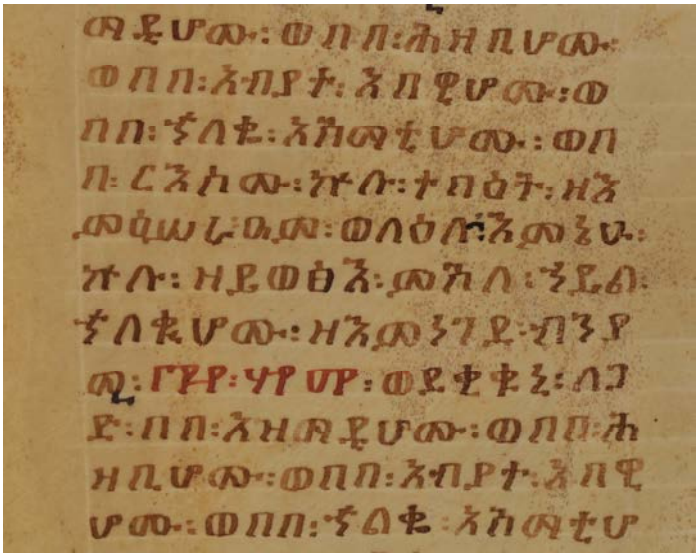

Fig. 2: Ms. UM-040, Octateuch, ʿUra Mäsqäl, fol. 93ra.

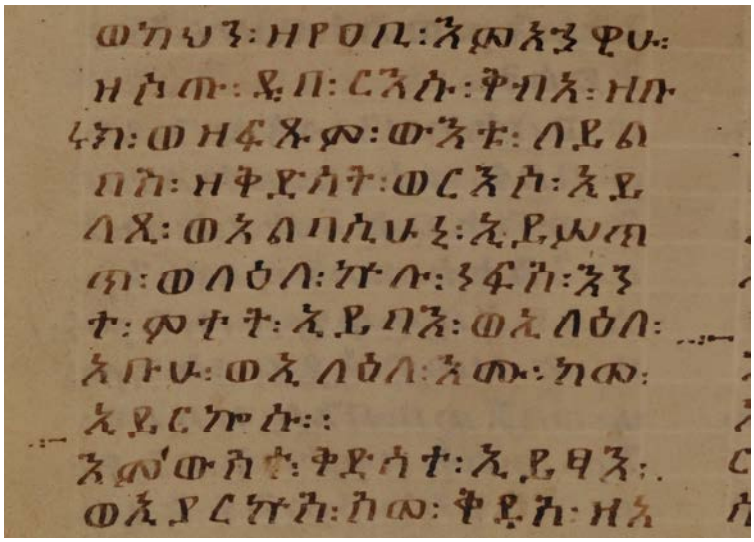

Fig. 3: Ms. UM-040, Octateuch, ʿUra Mäsqäl, fol. 101ra.

Vat. éthiop. 263, f. 85v.

Fig. 4: Ms. Vatican Library, aeth. 263, fol. 85v (van Lanschoot 1962, plate I)

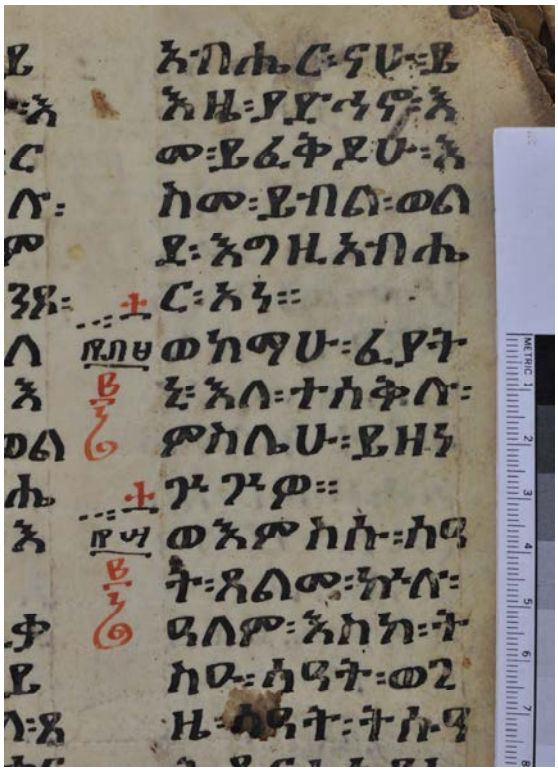

Fig. 5: Ms. UM-027, Four Gospels, fol. 78rb (Mt. 27:43-46).

Fig. 6: Ms. TGM-003, Fragment of a Four Gospel manuscript, ʔAmba Tähula Mikaʔel, fol. 1r (Jn. 7:22-28).

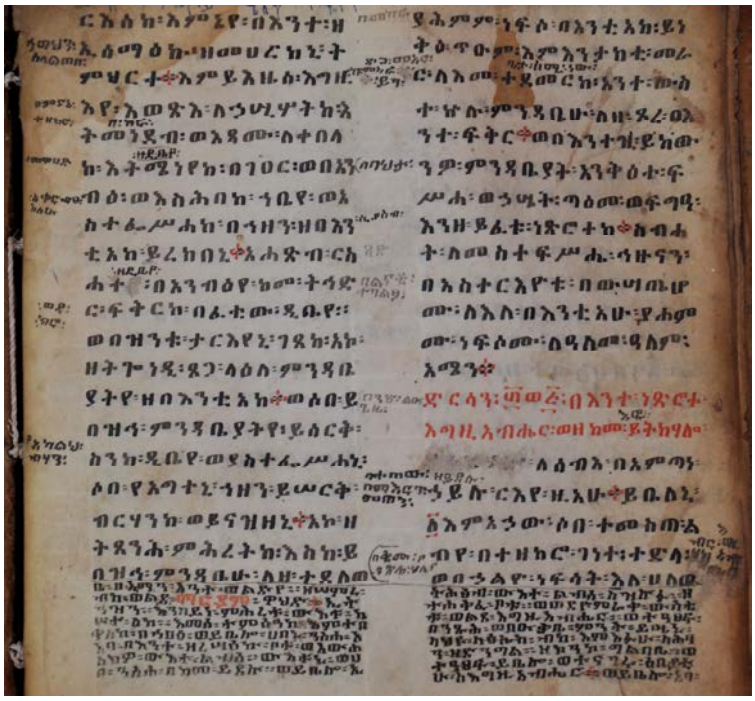

Fig. 7: Ms. MQMA-005, Spiritual Elder, Məngaś Maryam, fol. 15r.

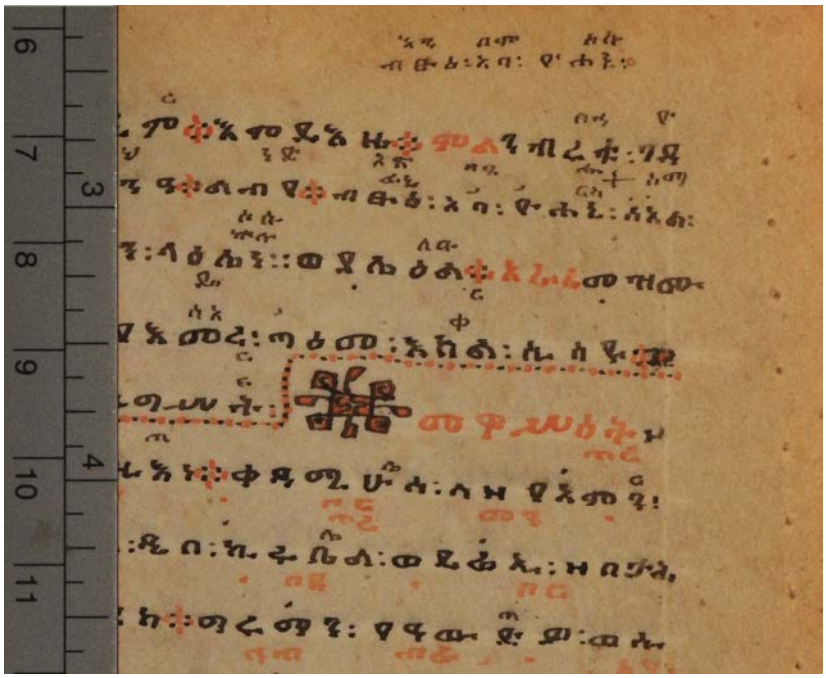

Fig. 8: Ms. TRM-017, Collection of chants, Taḥtay Ruba Maryam, fol. 122r.

Impressum

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