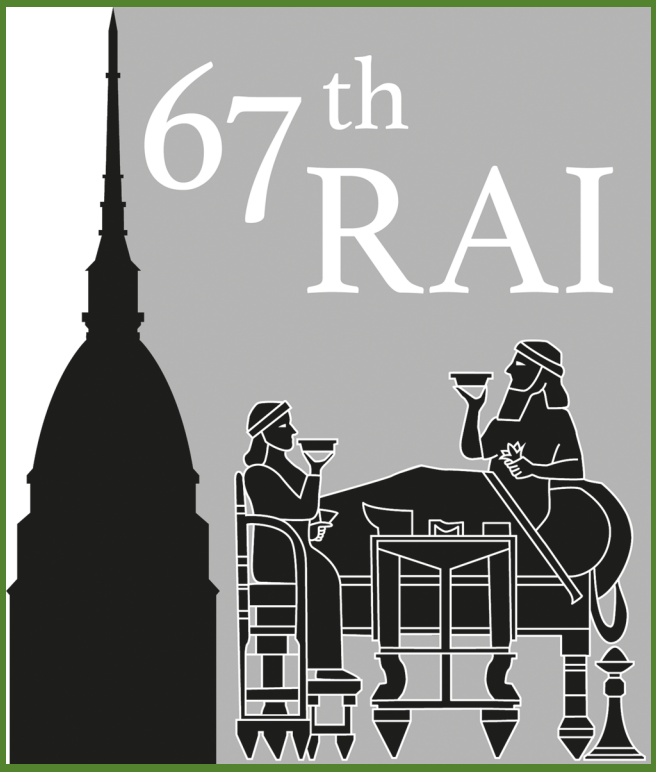

Eating and Drinking in the Ancient Near East

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Altorientalistische Publikationen
Publications on the Ancient Near East

Band 33

Herausgegeben von Kristin Kleber und Kai A. Metzler

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Zaphon
Münster
2024

Illustration on the cover: designed by Maria Letizia Ferri,
Department of Historical Studies, University of Torino.

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All the essays published in this volume have undergone a peer-review process.

2024 Zaphon, Enkingweg 36, Münster (www.zaphon.de)

Printed in Germany. Printed on acid-free paper.

ISBN 978-3-96327-272-1 (book)
ISBN 978-3-96327-273-8 (e-book)

ISSN 2627-7174

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An Old Babylonian Cylinder Seal from the Museo Orientale Umberto Scerrato

Notes on a Digital Microscopic High Magnification Analysis

Romolo Loreto

1. Introduction

Thirty-seven seals constitute a collection exhibit in the Museo Orientale Umberto Scerrato (MOUS) of the University of Napoli "L'Orientale". The lot was acquired during the 1960s of the last century by Professor of Semitic Studies Giovanni Garbini in order to give form to a permanent collection for educational purposes.[1] All of them, both cylinder and stamp seals were previously studied by L. Cagni,[2] S. Campurra Mazzoni,[3] and A. de Maigret[4] in the early 1970s; finally, they were described by S. Graziani in the catalogue of the MOUS, whose last edited version (2nd) appeared in 2018.[5]

Since the previous studies focused on the stylistic and iconographic features of both cylindrical and stamp seals, a technological study mainly addressed to engraving and intaglio techniques will be carried out within the laboratory activities of the MOUS and the teaching of Archaeology and Art History of the Ancient Near East at "L'Orientale". The collection is even more valuable because the seals cover a wide chronological range, stretching from the Akkadian to the Sassanian period, allowing to observe the technological changes that characterize the Ancient Near Eastern glyptic, based on a high magnification digital microscopic analysis approach and the support of 3D orthorectified models.

An Old Babylonian cylinder seal engraved with a worshiping scene is the main topic of this contribution. Nonetheless, in order to better suggest the possible identification of engraving and intaglio techniques, an Akkadian (MO255) and an Ur III cylinder seal (MO257) are taken into account for comparison.

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[1] Graziani, 2018: 20.
[2] Cagni, 1971; 1972.
[3] Campurra Mazzoni, 1972.
[4] De Maigret, 1974.
[5] Graziani, 2018.

The history of developments of seal-cutting techniques is deeply indebted to the studies of Sax / Meeks,[6] and Sax / McNabb / Meeks,[7] who were able to replicate experimentally the tool marks of the seal cutter on the basis of the British Museum collection of seals. It is on their results that one ventures in the collection of the MOUS.

1.1 The iconographies

The analysis here introduced takes place from an Old Babylonian cylinder seal (MO262, Fig. 1). It is a 2.2 cm high and 1.3 cm in diameter piece of haematite, the most common type of stone adopted right after the Akkadian period together with chlorite.[8] A double worshiping scene is engraved. On the left, the king offers a goat to the god Shamash who is holding his ritual knife, under the sun disc and the crescent; on the right, a "priest" or "attendant" is holding a bucket and a sprinkler (perhaps making a libation according to Cagni, 1971; Campurra Mazzoni, 1972; Graziani, 2018); the god Adad who is standing on a bull (perhaps a wild animal or a dragon according to Cagni, 1971; Campurra Mazzoni, 1972; Graziani, 2018) is holding a bolt or "lightning fork" with his right hand and an axe with is left hand and the wavy line is a sort of rope or leash attached to the nose of the bull on which the storm god stand. Under Adad and in front of him are quite visible two deep scratches that affected the seal otherwise well preserved.

MO255 (Fig. 1), a serpentine stone 3.4 cm high and 2 cm in diameter, shows a presentation scene, among the most frequent iconography of the Akkadian period: a doubled headed god (Usmu, vizir of Ea) introduces Zu, the bird-god, to the water god Ea sitting on his throne.[9] Behind Zu a third deity stands; behind Ea a kneeling nude attendant is holding the gate-pole under the lunar crescent, from where three fishes are swimming up towards the water god. Ea, sitting on a throne simply rendered by a vertical line, has his left shoulder bare, he is holding a jar with his right hand and his left arm addressed toward the upcoming visitors. The doubled headed god has his right shoulder bare and both arms bent towards his chest. Zu, whose lower half of the body reveals his bird nature, is followed by a last figure with a long skirt and his right harm on Zu's left shoulder. Ea has got a horned headdress; the doubled headed figure has a flat hat; Zu has got a diadem, possibly; the last figure after Zu has got a flat cap with two disks close to his head suggesting astral symbols connected with a natural myth or a different cap type (?). All of them have got a long beard. Ea wears the typical ruffles dress, whilst the other, apart from Zu, a long grooves skirt.

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[6] Sax / Meeks, 1994.
[7] Sax / McNabb / Meeks, 1998.
[8] Collon, 2005: 36, 41.
[9] Collon, 2005: 32–35.

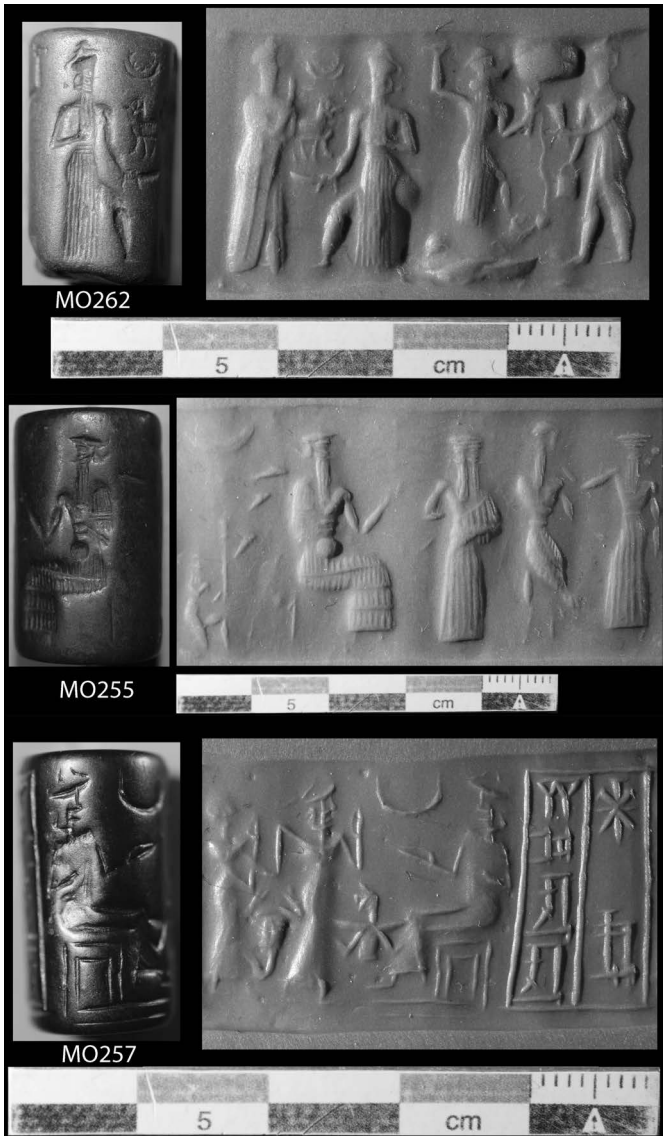

Fig. 1: MO262, MO255, and MO257. Seals and stamps on polymer clay.

The Ur III seal MO257 (Fig. 1), a serpentine stone 2.1 cm high and 1.2 cm in diameter, also displays an introductory scene rather standardized.[10] A worshiper is led by a goddess before a god or goddess (no beard clearly visible) seated on a box-like or panelled throne under the crescent. Between the figures a scorpion is visible, whilst between the leading goddess and the seated god/goddess also a

[10] Collon, 2005: 36.

winged figure stands, possibly a lion-headed eagle as in BM 119330.[11] Finally, an inscribed panel, that shall be discussed later on, is carved behind the back of the seated god.

1.2 Engraving techniques: state of the art

The amount of seals emerged from the Ancient Near East archaeological contexts is extremely varied and the abilities, techniques, and the general expertise of a seal cutter should have been resourceful as well. Factors in the making of a product include not only technical ones, such as the stone quality, the type of tools and abrasive agents adopted, but also the iconographic style, whose choice could be linked to the workshop or to the commissioner, or simply derived from the cutter himself (a master or an apprentice) and, of course, the amount of time and patience devoted to the task. As previously stated, the history of developments of seal-cutting techniques is deeply indebted to the studies of Sax / Meeks and Sax / McNabb / Meeks,[12] who were able to replicate experimentally the tools' marks of the seal cutter on the basis of both the seals collection of the British Museum and the usage and adoption of high quality stone types. Therefore, in this paper the same technical language used by Sax *et al.* (1998) is adopted, defining at first vertical, horizontal and diagonal orientations, then, to identify the tools' marks and technical details that can allow to define the engraving process.

Apart from a wide range of blended techniques, basically four main procedures are defined: micro-chipping by indirect or direct percussion, as well as a direct scratching or gouging (with a forward-backward movement) using stones or flint or obsidian or metal tools; filing or sawing by a metal very sharp file or saw; drilling by bow-drill or simply by bare handling a pointed drill tool; and wheel-cutting by vertical wheel or by horizontal wheel. All of them possibly include a wide range of variations based on the material, the fundamental charge of abrasives and the way of using the tools.

Among several diagnostic techniques, most of them adopted by Sax *et al.* (1998), it must be stressed that the most suitable instrument for a better detection of the most significant traces left by the working tools is the Scanning Electron Microscope (SEM), already used (together with X-ray) to analyse some cylinder seals' details, such us the central bore or the drill marks by Gorelick / Gwinnett.[13] SEM scans objects with a focused beam of electrons capable to interact with the atoms of the object, so that it defines the surface topography of the sample, at a scale able to give form to the most infinitesimal detail or sign that a peculiar tool can leave on the worked surface. More recently, Vidale / Angelini / Frenez carried

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[11] A close comparison is in Collon, 1982; num. 386; for further comparisons see Cagni, 1971: 96–97.

[12] Sax / Meeks, 1994; Sax / McNabb / Meeks, 1998.

[13] Gorelick / Gwinnett, 1978; 1979.

out a technological study on the Indus valley steatite (softstone) stamp seals by adopting a Laser Scanning Confocal Microscopy (LSCM), able to give form to a high definition 3D model.[14]

1.3 The adopted methodology

This contribution is based on both macro photography and 3D orthorestitutions of the seal itself and its stamp generated by macro lenses and the crucial usage of high magnification digital microscopes. Macro photography and macro 3D orthorectified models can provide not only a beautiful and suitable for museums' audience entertainment 3D model to play with, but also define first morphological details to recognize the most detectable engraving or intaglio techniques well attested during specific period of time.

Digital microscopes, stretching from 10x to 470x magnification rates are used to take the analysis to a higher level of definition. Although one has at its disposal the original seal, anyhow considered, it is known that micro technical details are better visible on the stamped moulded surfaces. The moulds adopted, up to now, are two: the wet polymer clay, useful to stamp the whole seal's surface in a single print, and a silicon impression material in order to better compare our stamped mould with the Sax *et al.* (1998) ones also made with silicon (for this contribution the use of hyperhydrophilic type 0, with a ISO 4823 putty consistency, that is able to detect up to 5 micron wide details, was preferred).

2. First steps towards a digital microscopic high magnification analysis

Coming to the Old Babylonian seal, a detailed analysis can be performed starting from Shamash arms (Fig. 2).

If one looks at a 250x magnification rate it is possible to distinguish that the whole arms, from shoulders to hands, are made from a continuous curvilinear deep mark, interrupted only by oblique marks at the wrists and vertical lines at the shoulders. Thus, only a continuous mechanical action could have provided such a smooth feature. It is also quite evident the cutting line between the hands and the wrists. So, according to Sax / Meeks,[15] only a mechanical wheel-cutting tool can engrave such curvilinear elements.

To better understand the technique, one can have a look at the Ur III seal MO257, where the arms of the participants to this introductory scene are rendered by two straight line, a vertical one and/or an oblique one (Fig. 3a): there is no sign of a curvilinear mechanical action. The oblique line, according to Sax / Meeks should be the result of sawing or filing;[16] on the contrary, the vertical lines cannot be the result of such instruments (a saw applied vertically to the seal would have

[14] Vidale / Angelini / Frenez, 2018.
[15] Sax / Meeks, 1994: 156.
[16] Sax / Meeks, 1994: 156.

cut it all along its vertical axis, from the top to the bottom edges), but only of a wheel or micro chipping or scratching. Also, if one compares Shamash arms and shoulders with the last figure in the Akkadian seal (Fig. 3b), clearly two different engraving techniques emerge, a wheel-cutting one and a tool hand-held procedure the other, that is a coarser engraving procedure. As it is known, according to Sax / McNabb / Meeks and Collon the introduction of the wheel-cutting technique is later than usually believed and must be dated to the first half of the II millennium BCE (Age of Hammurabi).[17] Thus, we do not recognize the usage of such a mechanical and efficient instrument on the Akkadian seal, whilst it is attested in MO262, which is most probably attributable to the 19th–18th cent. BCE.

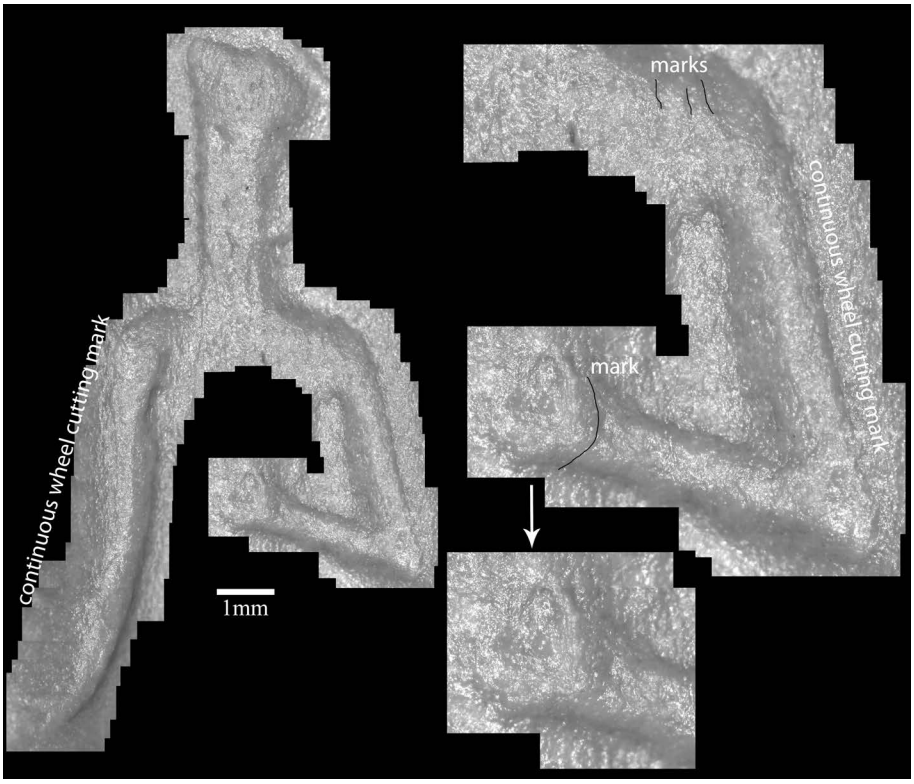

Fig. 2: 250x magnification rate photomosaic of Shamash.

It is also useful to look at the arms of Adad (Fig. 3c). His left arm once again shows a continuous curvilinear fine shape, from the shoulder to the hand; on the contrary the right arm shows a less accurate intaglio, with an interruption at the elbow. Such a difference could derive from a wrong usage of the wheel-cutting

[17] Sax / McNabb / Meeks, 1998: 20; Collon, 2005: 52.

tools or from the usage of another tool or is attributable to a typical style, indeed comparisons for this detail are quite abundant (BM 134760, BM 89298).

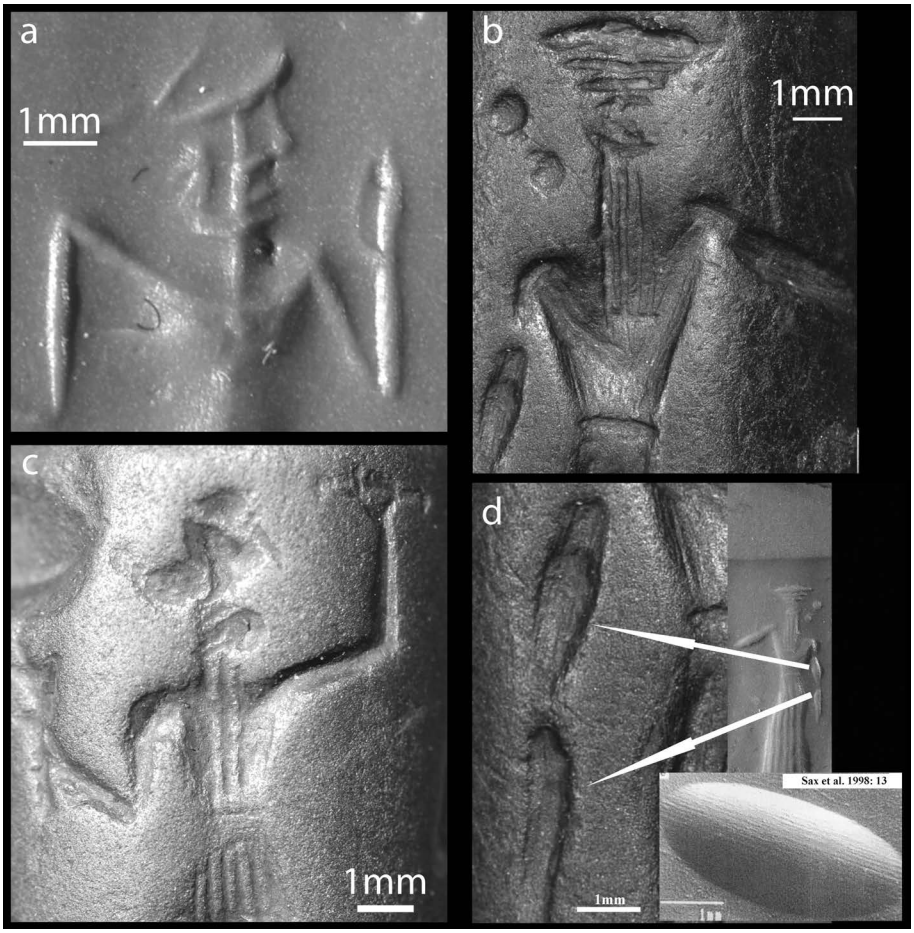

Fig. 3: Details of the arms' intaglio techniques: a) MO257; b) MO255; c) MO262; d) MO255 compared to the experimental marks obtained by Sax *et al.*, 1998.

A further element arose by comparing the intaglio techniques of the arms, it can be found again on seal MO255, the Akkadian one (Fig. 3d). The left arm of the last figure in the scene shows signs of saw or file cutting tools comparable to the experimental marks reproduced by Sax / McNabb / Meeks.[18] In this case, by going on with a 470x magnification rate it is also possible to appreciate the very detailed features of a saw or file tool (Fig. 4a): straight marks, with a triangular regular profile, less than a half millimetre thick, clearly marks of a rather sharpened tool.

[18] Sax / McNabb / Meeks, 1998: 13.

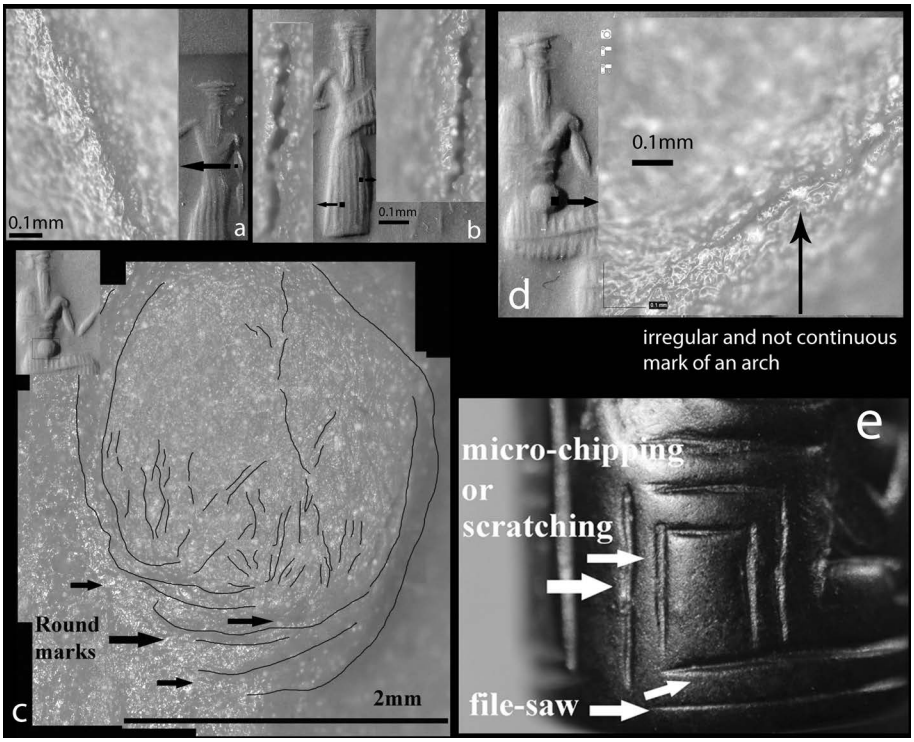

Fig. 4: Details of MO255 and MO257 regular and irregular marks: a) MO255, straight marks, with a triangular regular profile (470x); b) MO255, irregular marks (470x); c) Ea's jar (250x); d) detail of the Ea's jar at 390x; e) comparison between straight marks (file or saw) and irregular marks (scratching or micro-chipping) in MO257.

To better appreciate the most accurate details of tool's mark, one can compare this last feature with the garment of the double-faced god in the Akkadian MO255. In this case, the garment shows marks of a less accurate instrument (Fig. 4b), resulting from scratching or micro-chipping. Indeed, even at a macro scale some marks are recognizable. Both the garment of the standing figures and seated Ea show non parallel and irregular lines. This is also the case of the linear features of the inscribed panel and god's throne in the Ur III MO257 (Fig. 4e). All the horizontal lines, made by using a saw or file, are straight and regular marks, with a constant thickness, whilst all the vertical elements are characterized by irregular marks, thicker in their upper part and thinner in the bottom edge, most probably resulting from the usage of a scratch or a chipping procedure: basically one can see here the first impact point of the scratcher or chipper right where the groove is larger.

Among the rough techniques visible, one could probably include the making of the cultic water jar held by Ea (Fig. 4c). This rounded element is clearly made thanks to the usage of a tool driven by a revolving movement, apparently a fine one, if we limit the analysis to a macro scale. In fact, one can dissertate if the tool

is a hand-held pointed instrument or a mechanical bow-drill by looking at high magnification different scales. Looking at a 250x magnification rate, one can easily recognize both rounded irregular marks along the edge of the jar, traces of a revolving movement, and vertical marks that testify to the secondary usage of chipping or scratching to deepen the spherical part of the jar. Also, by looking at a 390x magnification detail of the jar (Fig. 4d), it is possible to recognize irregular and not continuous marks in shape of arches parallel to the circumference of the jar. There are no traces of very regular and concentric marks that a bow-drill can leave on the seal,[19] but only traces of a hand-held procedure. Nonetheless, the surface of the rounded element seems to be also partially smoothed by the action of abrasive, that may have removed more clear tool marks.

3. Conclusion and perspectives

This contribution is an attempt to proceed with a complete updated re-publication of the MOUS seals corpus by adopting an archaeological perspective based on the lapidary techniques study, the production of an iconographic photo-documentation still poorly accomplished in previous publications as well as to generate a museum's audience accessible 3D models following the dissemination vocation of the MOUS.

Moreover, one last issue could be introduced, that is the support that this kind of high magnification analysis can give to the detection of fake artefacts. On this regard, the case of Ur III MO257 is an example (Fig. 5). Already Cagni supposed that according to the poorly quality of the engraved garments of the standing figures, the orientation of the legs of the seated figure, and the orientation of the arms of the standing figures this seal could be considered a fake.[20]

Nonetheless, as far as the seal legend concerns, it is possible to observe some signs mistakenly written, in particular the front extension in the sign KAL (Fig. 5a).[21]

Line 1: DIĜIR-dan
Line 2: dumu ha$^{!}$-DU$^{!}$(UŠ).DU$^{!}$(UŠ)

[19] Sax / McNabb / Meeks, 1998: 15.
[20] Cagni, 1971: 96–97.
[21] Line 1: the additional wedge in the front part of the sign KAL also appears in CUSAS 6 1544. Line 2: the patronoymyc dumu ha.DU.DU occurs in NATN 882, where the name of the scribe is ur-^{d}kal-kal, of which the writing in MO257 could be an odd abbreviation (or copy). Differently from the carving of the scene, the legend is of poor quality, and the signs are either wrong or irregular in terms of paleography. The author owes the reading and interpretation of the inscription to Noemi Borrelli: to her goes my gratitude.

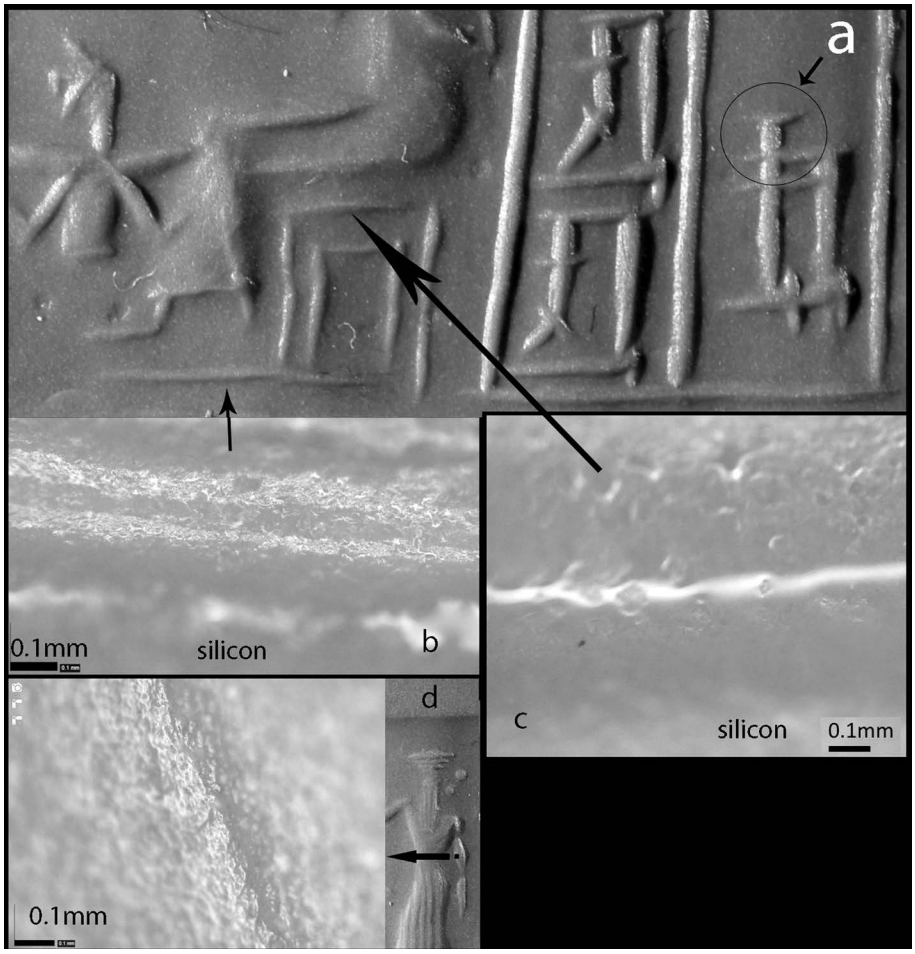

Fig. 5: Details of MO257 inscription and throne's marks resulting from a saw or a file and compared to the MO255: a) the sign KAL mistakenly written, the wrong part is highlighted; b-c) horizontal mark resulting from a saw or file on MO257 (470x, silicon paste); d) MO255 diagonal mark resulting from a saw or file (470x, polymer clay).

So, either this is a mistake made by a modern falsifier or this is a mistake made in antiquity, maybe a mistake made by the seal cutter itself, not necessarily an erudite. From a microscopic approach it is possible to suggest to compare the tool marks left on the Ur III seal with others. For example, by looking at the clearly identified marks of a saw on both the Ur III and Akkadian seals (Fig. 5b–d). The marks apparently match, both in their triangular profile and in the straightness of the lines, even when different pastes for the mould are used: polymer clay or silicon. There is not such a poorly engraving techniques as noted by Cagni after all,[22] thus the MOU257 Ur III seal should not be a fake.

[22] Cagni, 1971: 96–97.

To conclude, this brief preliminary analysis pointed out how a diachronic study of the intaglios techniques performed by macro photography and usage of digital microscopes on still poorly known seals collection, as it is the case of the MOUS one, could better support the definition of such archaeological materials, from a wide range of perspectives. More will follow, hopefully, on the whole corpus of seals of the MOUS.

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