‘CRAFTING’ SOCIAL STRATEGIES OF POWER IN NEOPALATIAL CRETE. A SOCIAL JOURNEY THROUGH THE TALISMANIC STONES

by

Barbara Morda

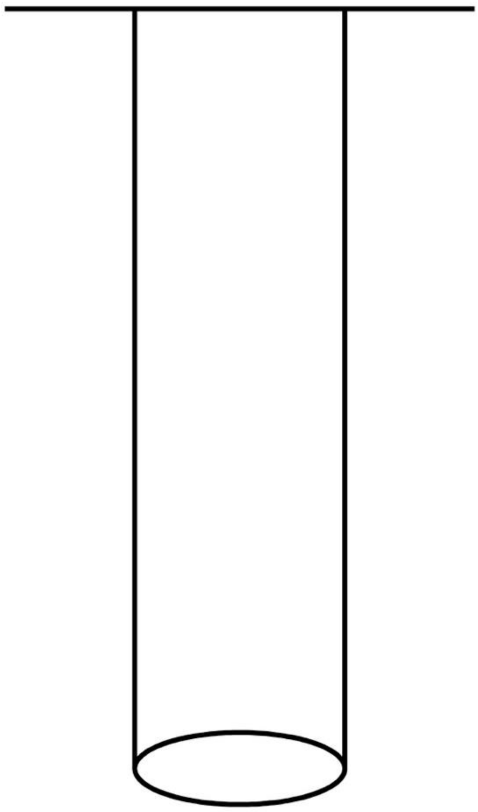
Volume 2

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy Department of Classical and Archaeological Studies

School of European Culture and Languages
University of Kent
June 2019

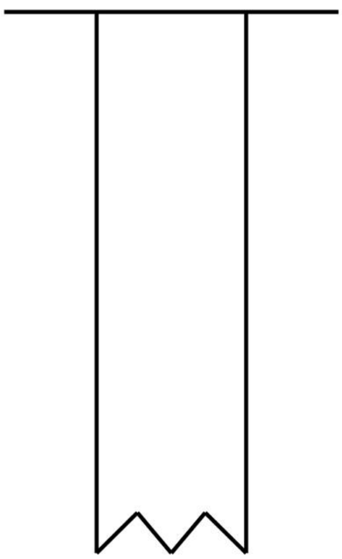
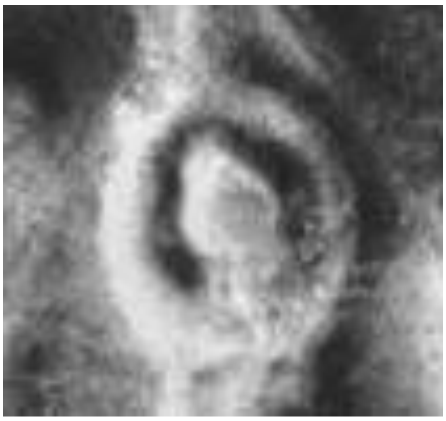
Chapter 4 - Plate 1

Tubular drill

Fig. 1 Tubular drill	Fig. 2 Example of circle
	
	
	Fig. 3 Example of semicircle

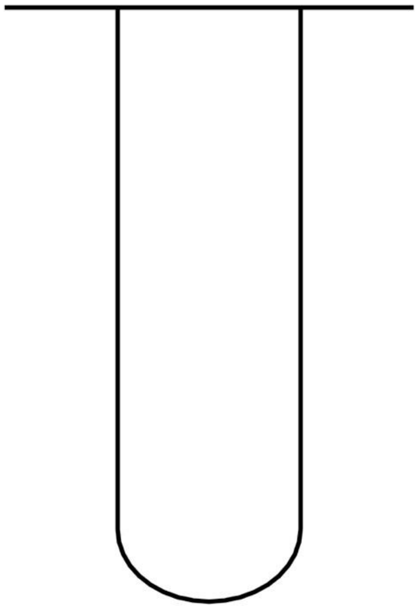
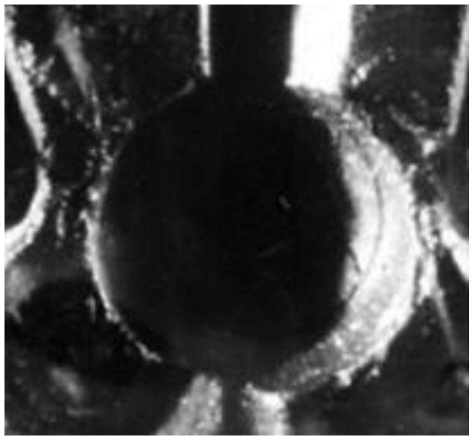
Chapter 4 - Plate 2

Tubular drill with central dot

Fig. 1 Tubular drill with central dot	Fig. 2 Tool mark on the seal surface
	
	
	Fig. 3 Impression

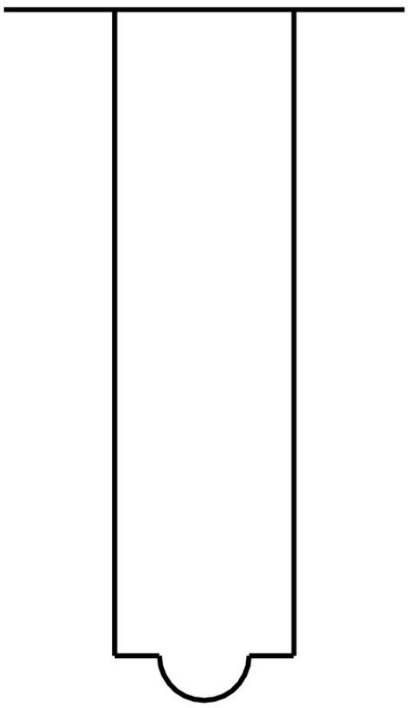
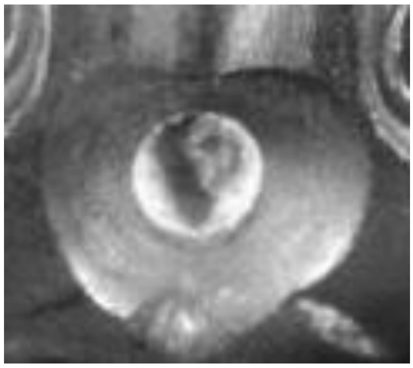
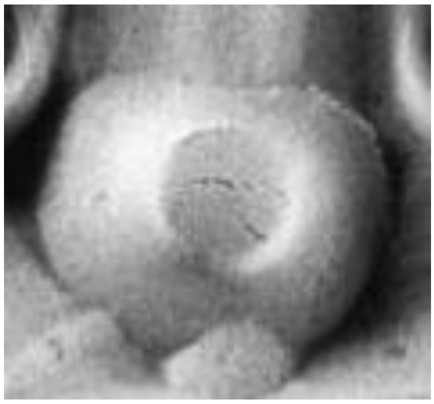
Chapter 4 - Plate 3

Solid drill

Fig. 1 Solid drill	Fig. 2 Tool mark on the seal surface
	
	
	Fig. 3 Impression

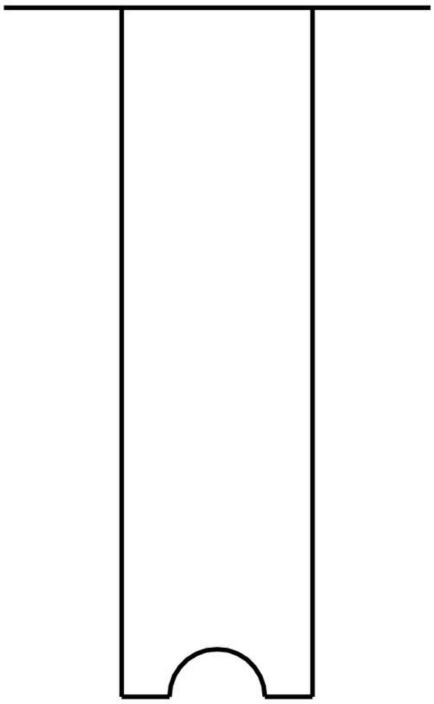
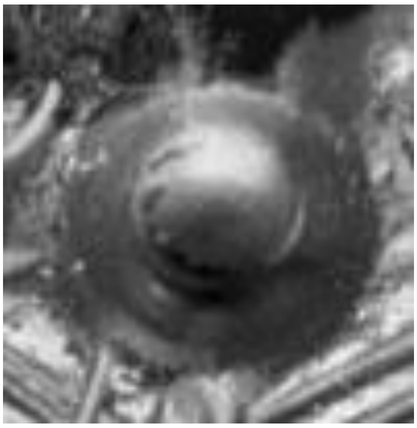
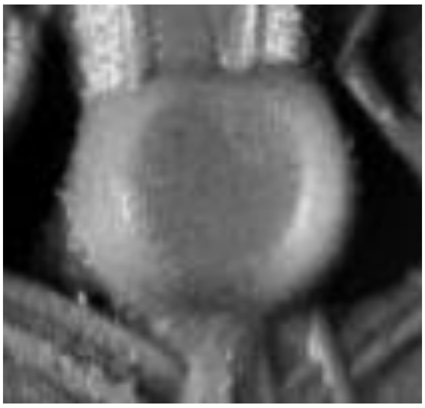
Chapter 4 - Plate 4

Solid drill with central convex dot

<table>
<tr><td>Fig. 1 Solid drill with central convex dot</td><td>Fig. 2 Tool mark on the seal surface</td></tr>
<tr><td rowspan="2"></td><td></td></tr>
<tr><td></td></tr>
<tr><td></td><td>Fig. 3 Impression</td></tr>
</table>

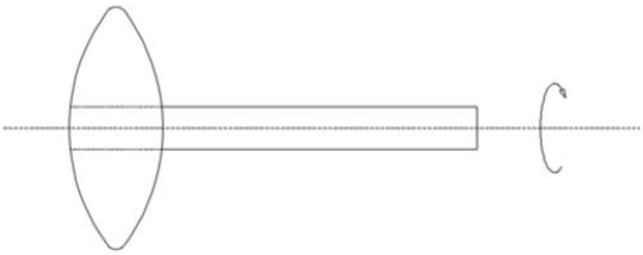
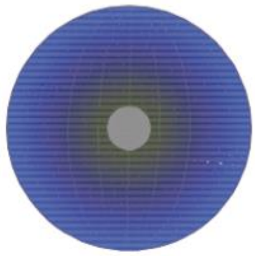
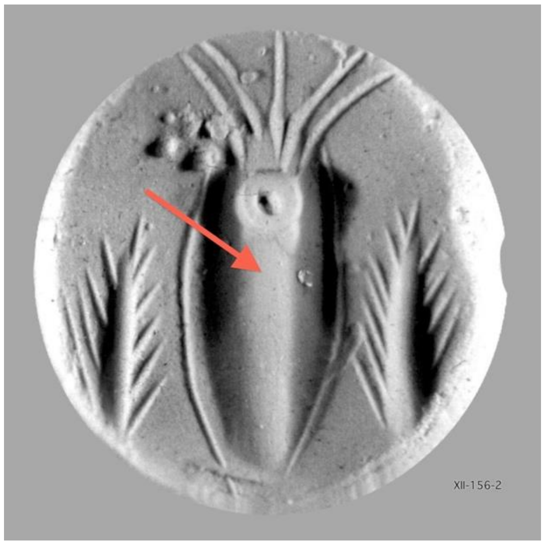
Chapter 4 - Plate 5

Solid drill with central concave dot

Fig. 1 Solid drill with central concave dot	Fig. 2 Tool mark on the seal surface
	
	
	Fig. 3 Impression

Chapter 4 - Plate 6

Cutting wheel

Fig. 1 Tool	Fig. 2 Disc shape
	
Tool marks	
The body of a Cuttlefish	
	
Fig. 3 Carnelian CMS XII No. 156 (Ca No. 143)	Fig. 4 Impression of CMS XII No. 156

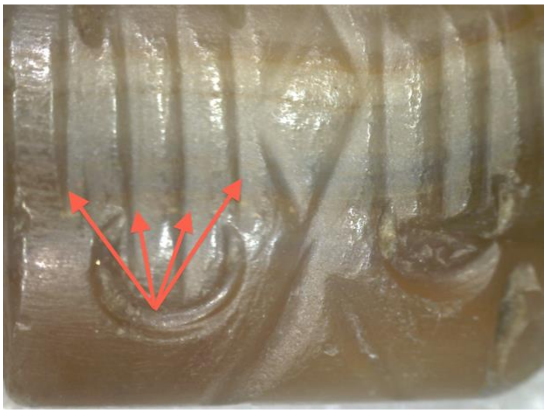


Fig. 5 CMS XII No. 149 (Ag No. 63)
Thin wheel: tool marks

Fig. 6 CMS XII No. 165 (Ja No. 55).
Broad wheel: tool marks

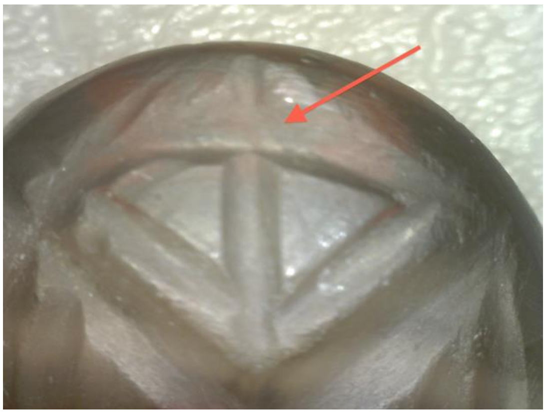


Fig. 7 CMS XII No. 147 (Qu No. 4).
Double axe: detail

Fig. 8 Impression

Chapter 4 - Plate 7

Composition: the motif of the amphora

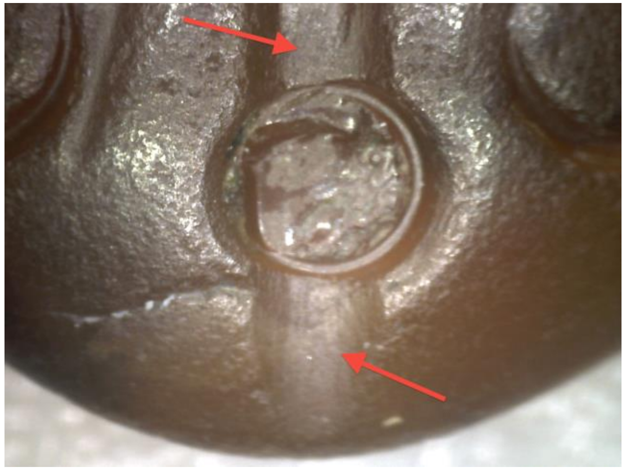
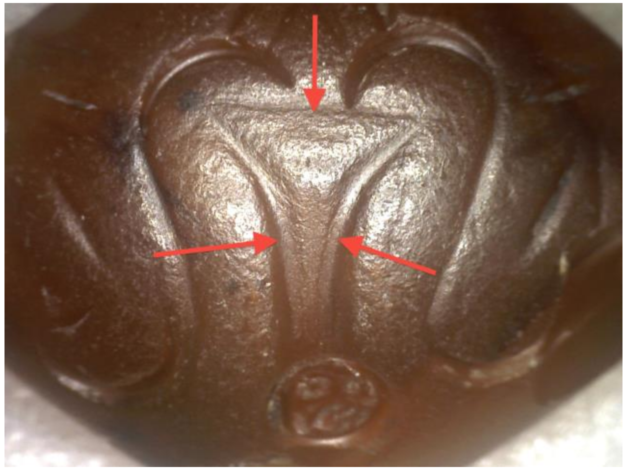
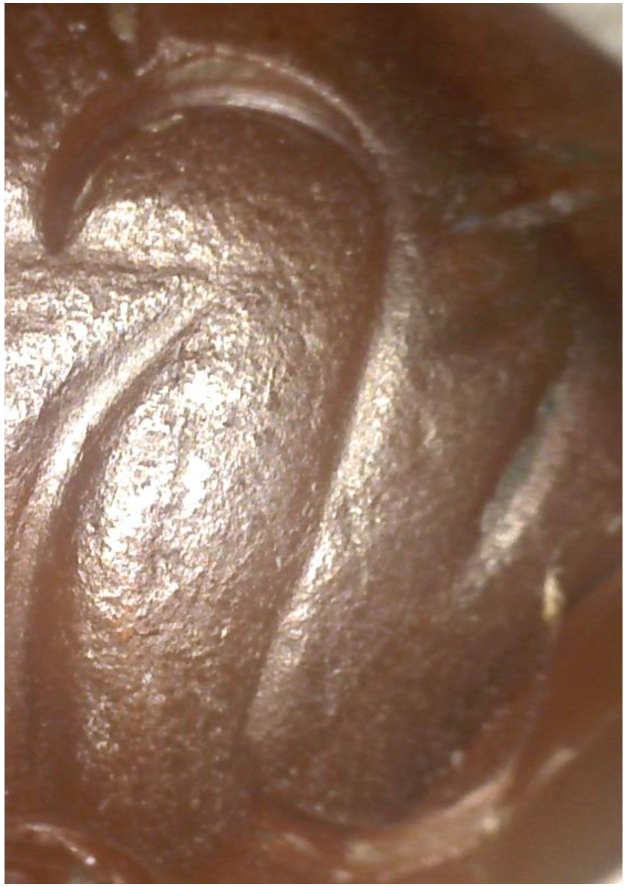
		

Fig. 1 First cut: made by a broad cutting wheel	Fig. 2 Second cut: circle made by a tubular drill	Fig 3 Three lines for neck and rim made by a thin cutting wheel

		
Fig. 4 the semicircle overlaps the cut used to create the rim of the amphora	Fig. 5 right handle made by the S-shaped cut	Fig. 6 left handle made by the S-shaped cut

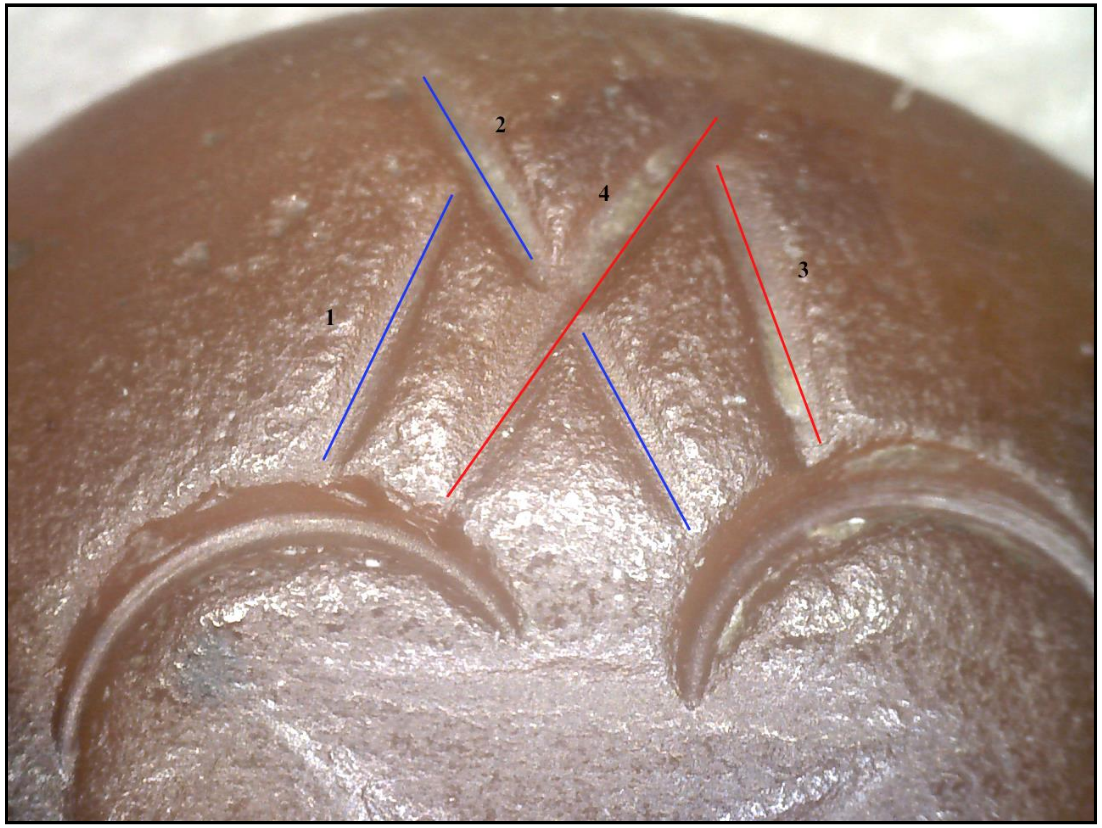


Fig. 7 Sequence of the cuts which create the lid of the amphora

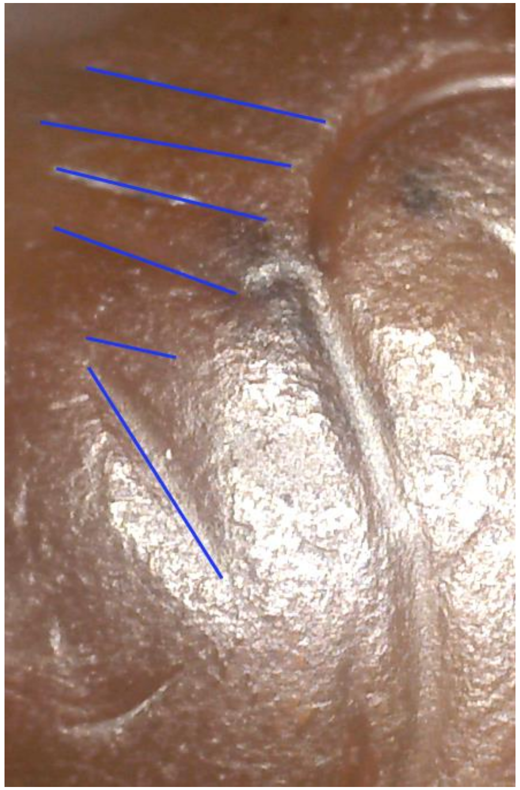


Fig. 8 Plant disposed on the left side of the seal surface		Fig. 9 Plant disposed on the right side of the seal surface

Fig. 10 CMS XII No. 143 (Ca No. 11)

Fig. 11 Impression

Chapter 4 - Plate 8

Composition: the motif of the jug

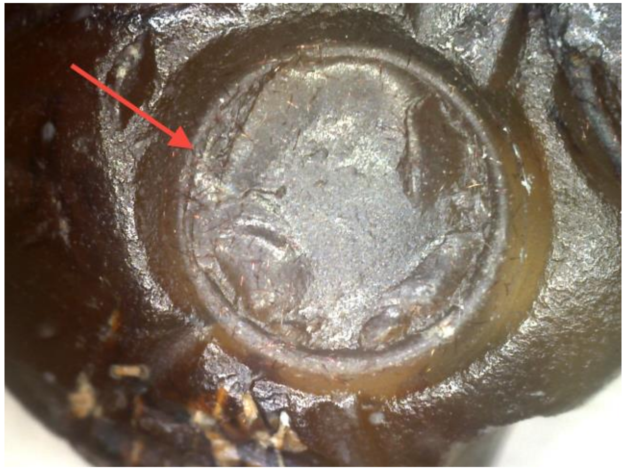
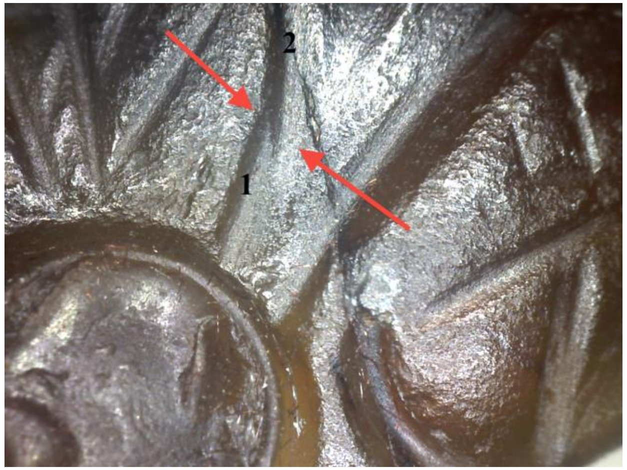
	

Fig. 1 Circle used for creating the belly of the Jug	Fig. 2 double cut created by the cutting wheel on the left line of the neck	Fig. 3 Creation of the neck by three lines

		
Fig. 4 Creation of the rim by two lines	Fig. 5 Creation of the foot by 4 cuts	Fig. 6 Creation of the handle

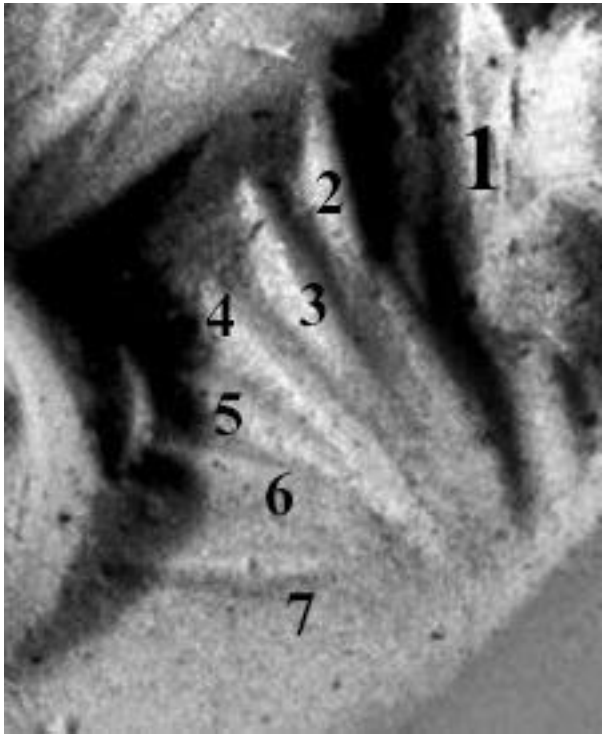
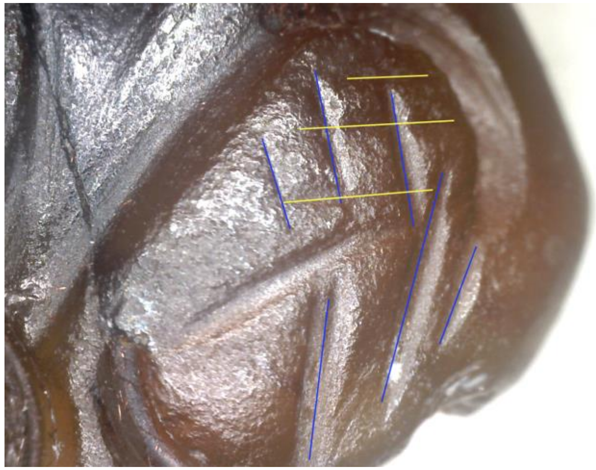
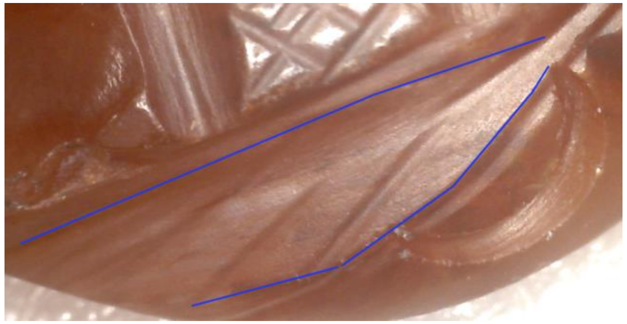
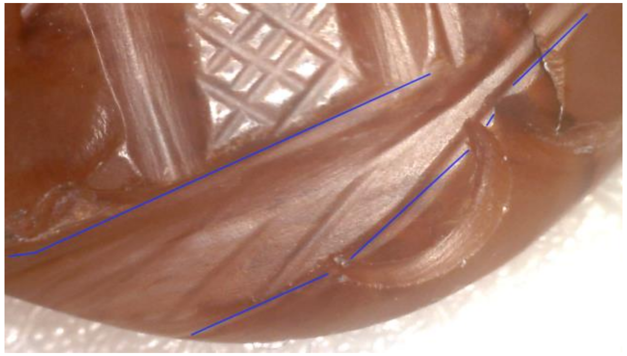
<table>
<tr><td></td><td>
</td><td></td></tr>
<tr><td>Fig. 7 First plant disposed on the left side of the seal surface. The blue lines have been engraved first</td><td>Fig. 8 Second plant disposed on the left side of the seal surface: detail of the impression</td><td>Fig. 9 Cross hatching disposed inside of the S-shaped cut. The blue lines have been engraved first. Three lines can be seen on the right side of the handle.</td></tr>
</table>

	
Fig. 10 CMS V No. 207 (Ca No. 40)	Fig. 11 Impression

Chapter 4 - Plate 9

Composition: the motif of the ship's prow





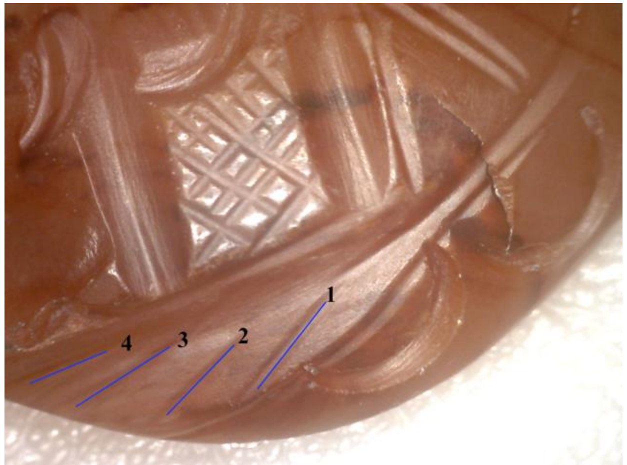


Fig. 1 Prow of the ship	Fig. 2 Lines which contour the first cut	Fig. 3 four lines overlapped on the first cut

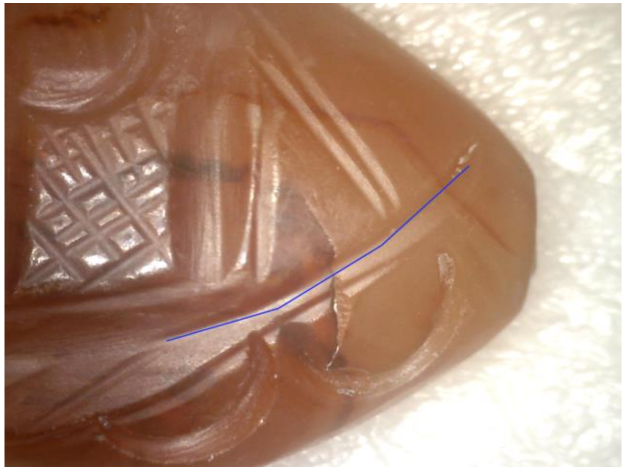
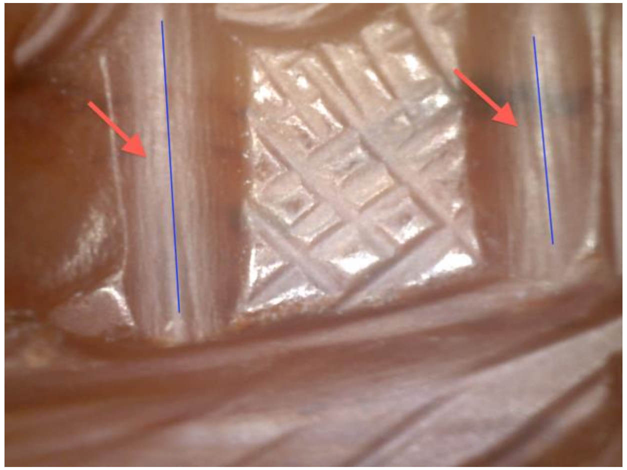
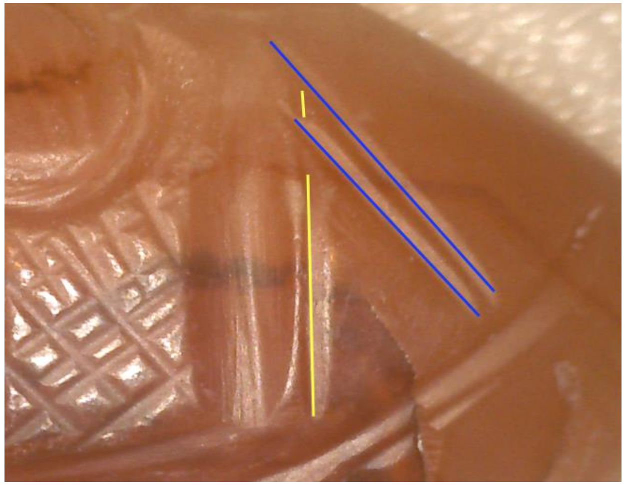
		

Fig. 4 Lines which shape better the ship's prow	Fig. 5 The blue lines have been engraved after the two cuts indicated by the red arrows	Fig. 6 The blue lines have been engraved after the yellow one.

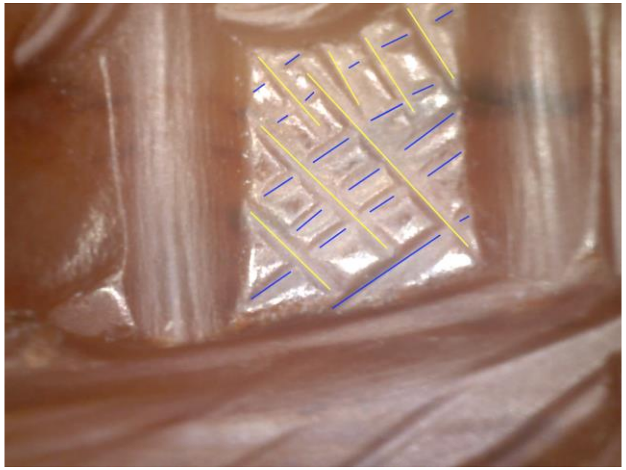
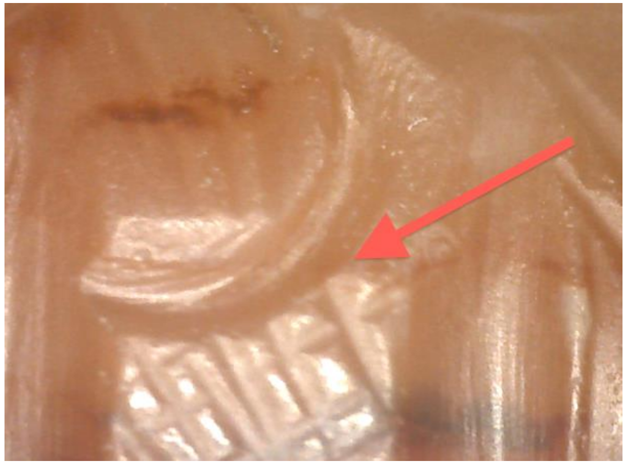
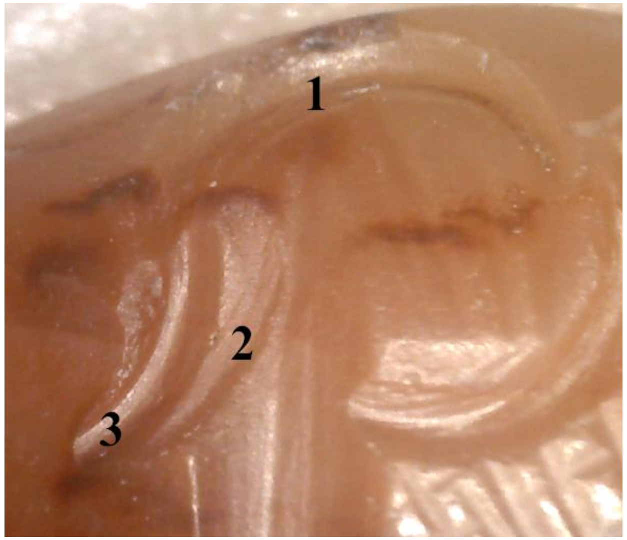
		

Fig. 7 Cross hatching: 13 lines can be counted. The blue lines have been engraved before them.	Fig. 8 Detail: the semicircle overlapping the cross hatching	Fig. 9 Semicircles disposed on the left mast

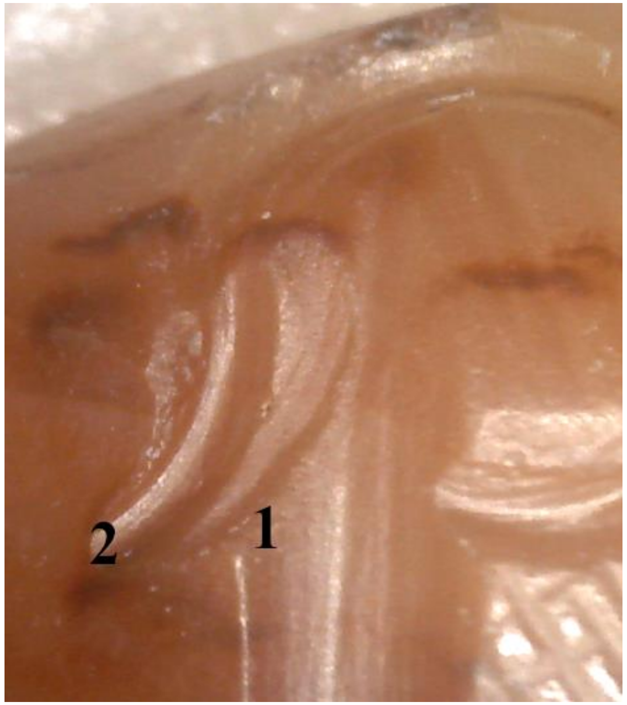


Fig. 10 A possible mistake of the engraver		Fig. 11 Semicircles disposed under the prow

	
Fig. 12 CMS XII No. 224 (Ca No. 98)	Fig. 13 Impression

Chapter 4 - Plate 10

Composition: the motif of the plant

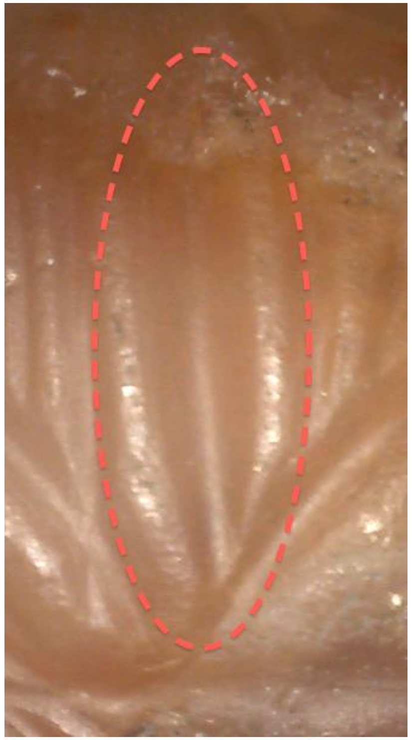
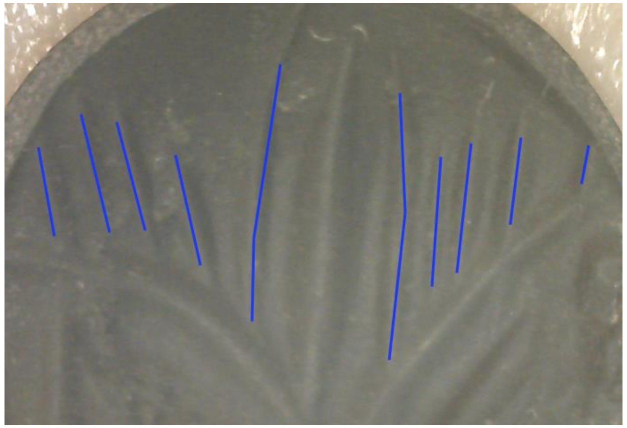
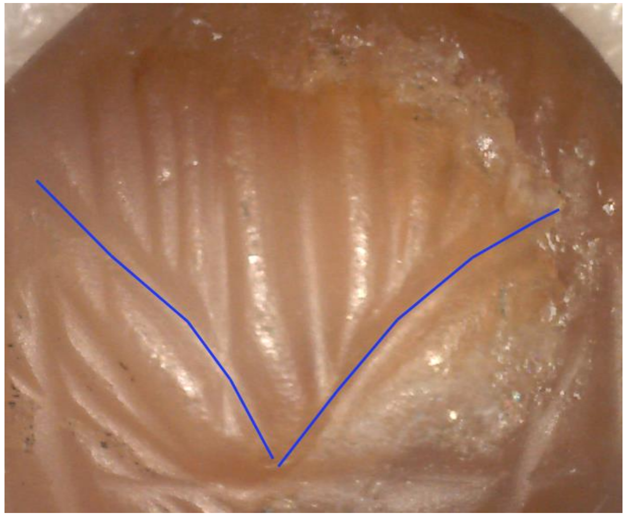
		

Fig. 1 Elongated cut	Fig. 2 Lines visible on the impression	Fig. 3 V-shaped cut

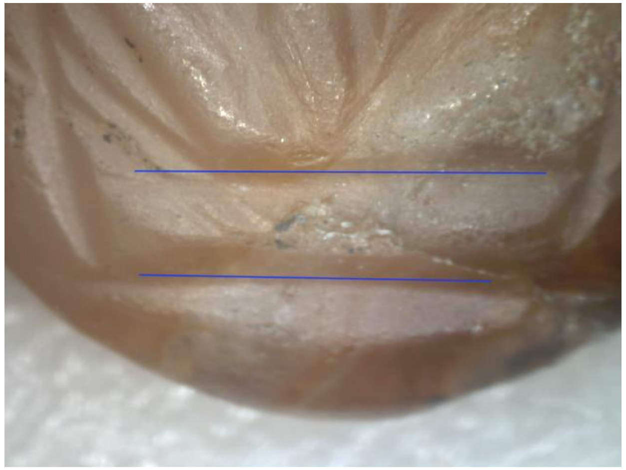
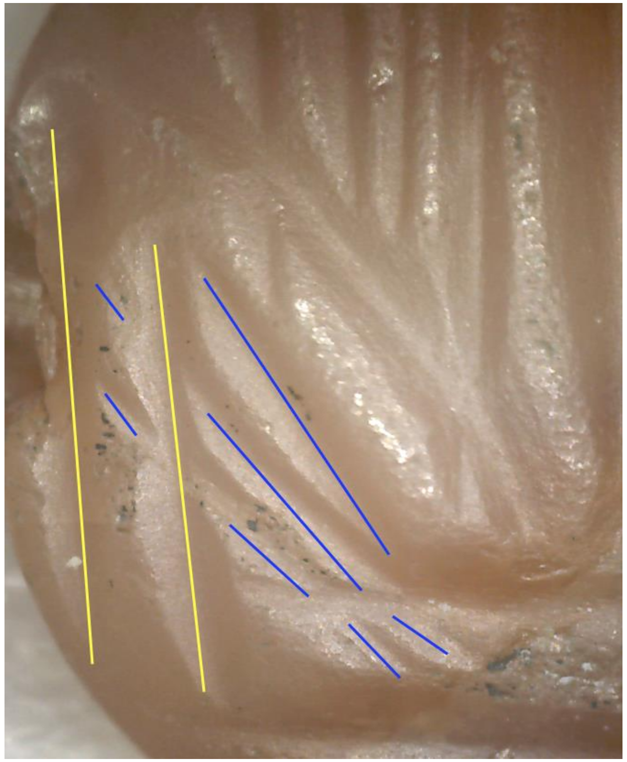
	

Fig. 4 Parallel lines	Fig. 5 Lines on the lower left side of the seal surface	Fig. 6 Lines on the lower right side of the seal surface

Fig. 7 CMS XII No. 154 (Ca No. 113)

Fig. 8 Impression

Chapter 4 - Plate 11

Composition: the motif of the cuttlefish

		
Fig. 1 The body of the cuttlefish	Fig. 2 Lines which contour the body of the cuttlefish	Fig. 3 Semicircle disposed at the top of the body of the cuttlefish

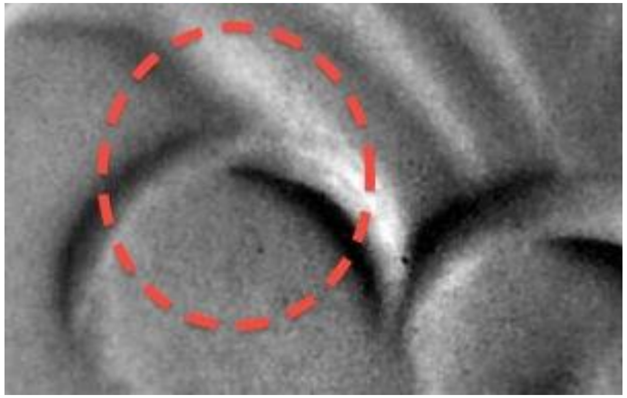
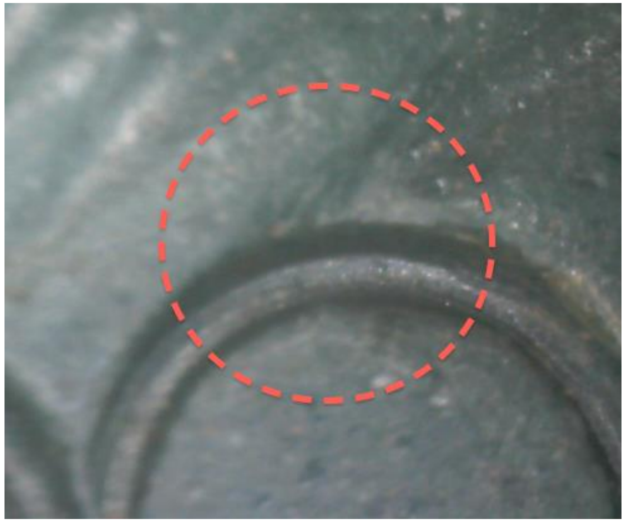
	

Fig. 4 Semicircle disposed at the top of the body of the cuttlefish visible on the impression	Fig. 5 Semicircle disposed at the top of the body of the cuttlefish	Fig. 6 Ten lines representing the tentacles of the cuttlefish

		
Fig. 7 Left fin		Fig. 8 Right fin

Fig. 9 CMS XII No. 152 (Ja No. 40)

Fig 10 Impression

Chapter 4 - Plate 12

Composition: the motif of the crab

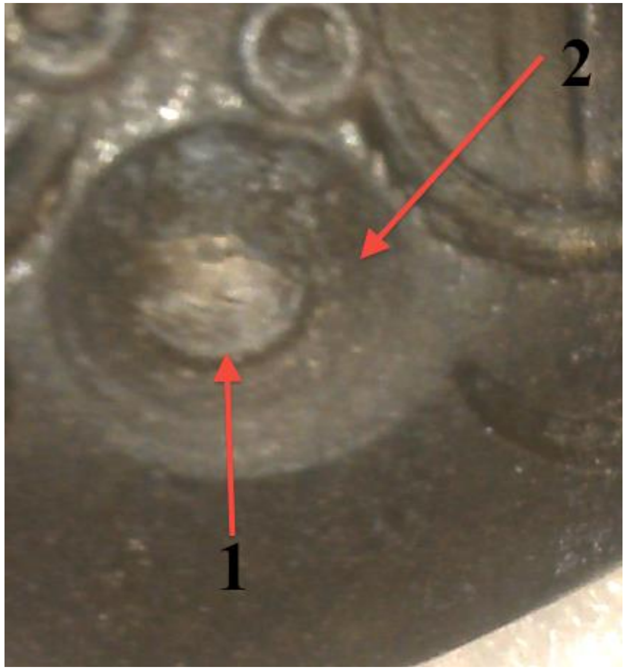
		
Fig. 1 Circle	Fig. 2 Double cuts: 1 Solid drill; 2 Tubular drill	Fig. 3 Semicircles for the creation of the legs

		
Fig. 4 Two circles made by a tubular drill	Fig. 5 Lines which appear only on the left side of the crab	Fig. 6 Three circle made by the combination of the solid and tubular drills

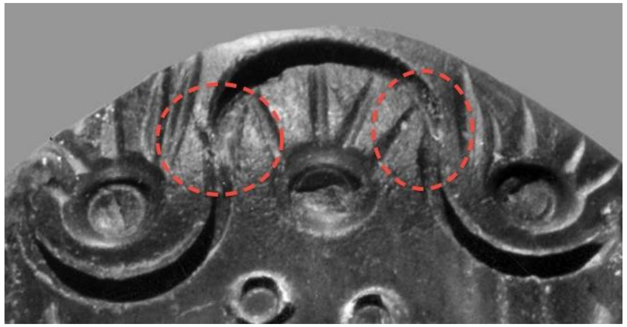
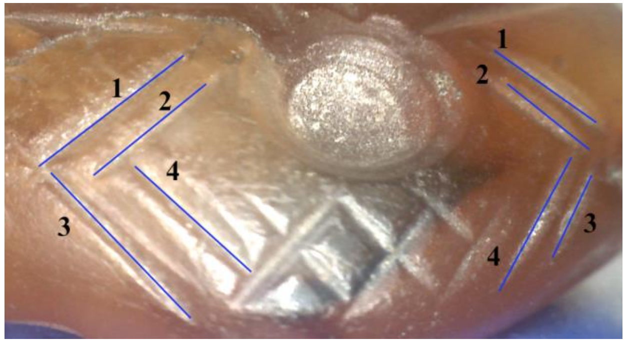
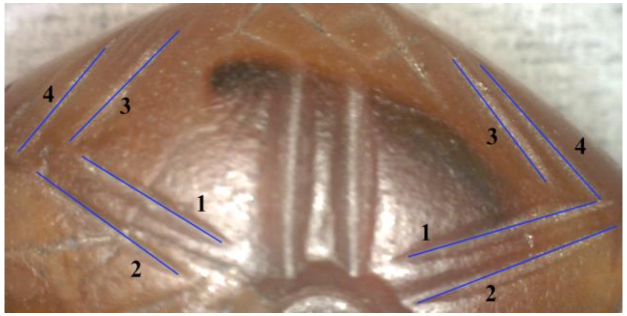
		
Fig. 7 Detail: impression showing the lines disposed on each semicircles.		Fig. 8 Detail of the impression. Both points of the semicircles have been damaged by the other overlapped cuts.

Fig. 9 CMS XII No. 179 (UnS No. 43)

Fig. 10 Impression

Chapter 4 - Plate 13

Composition: the motif of the spider

		
Fig. 1 Circle made by a combination of two solid drills	Fig. 2 Sequence of the cuts for the creation of the legs	Fig. 3 Sequence of the cuts for the creation of the legs

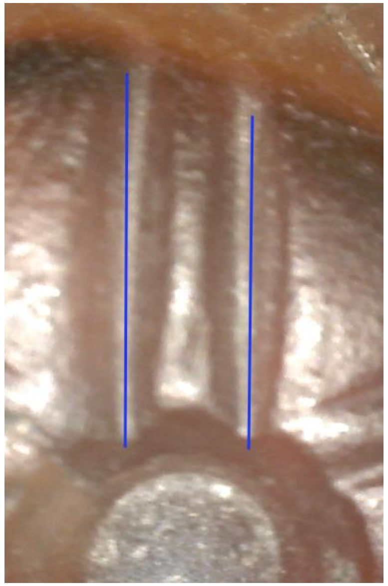
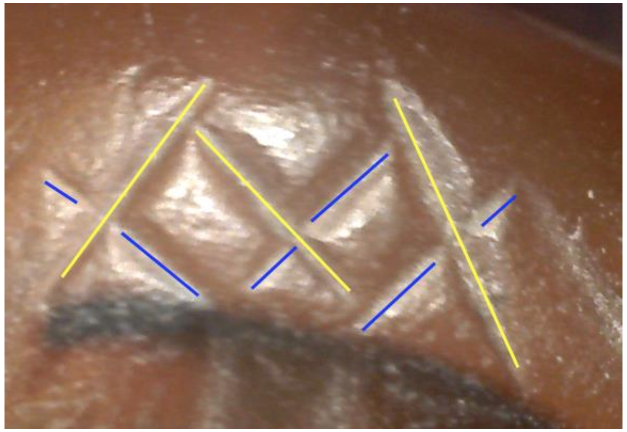
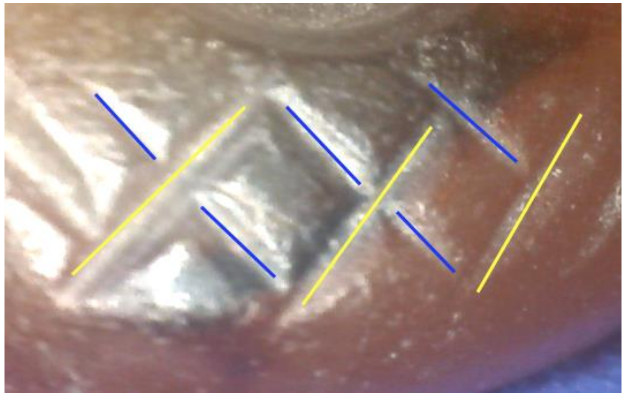
		

Fig. 4 Two straight cuts for the creation of the palps of the spider	Fig. 5 Cross-hatching disposed at the top of the figure. The blue lines have been cut first	Fig. 6 Cross-hatching disposed under the figure. The blue lines have been cut first

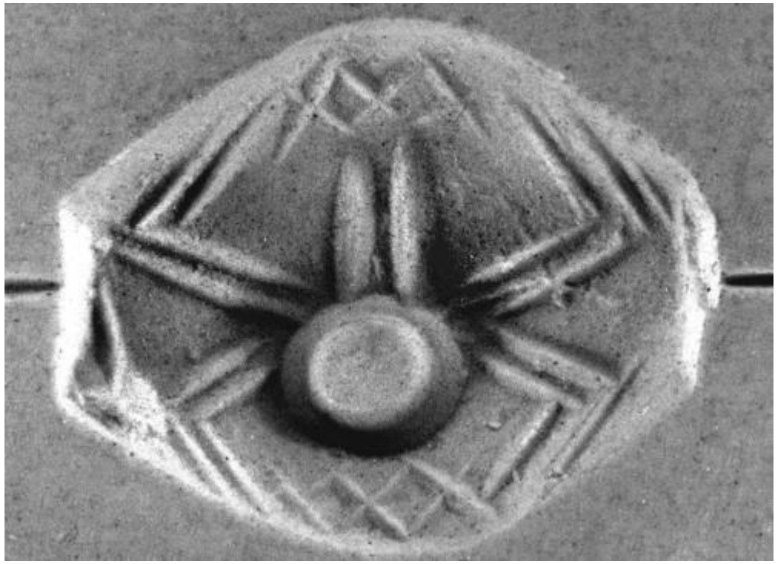


Fig. 7 CMS I No. 464 (Ca No. 183)	Fig. 8 Impression

Chapter 4 - Plate 14

Composition: the motif of the scorpion

		
Fig. 1 The body of the scorpion drafted by a broad wheel	Fig. 2 Semicircles disposed on the body of the scorpion	Fig. 3 Creation of the tail constituted by a straight line and a semicircle

Fig. 4 Detail of the three lines

Fig. 5 Legs disposed on the left side of the figure

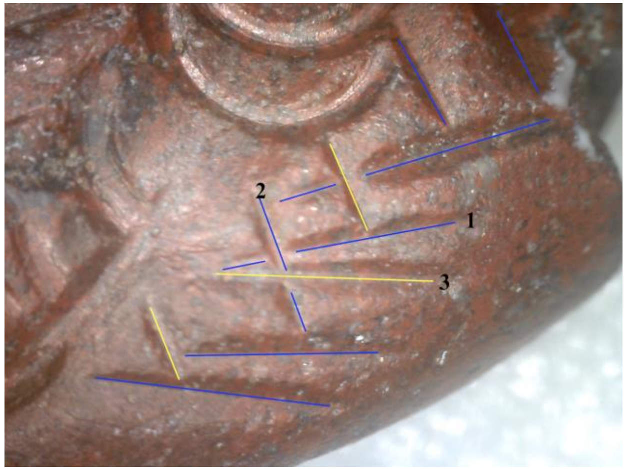


Fig 6 Legs disposed on the right side of the figure

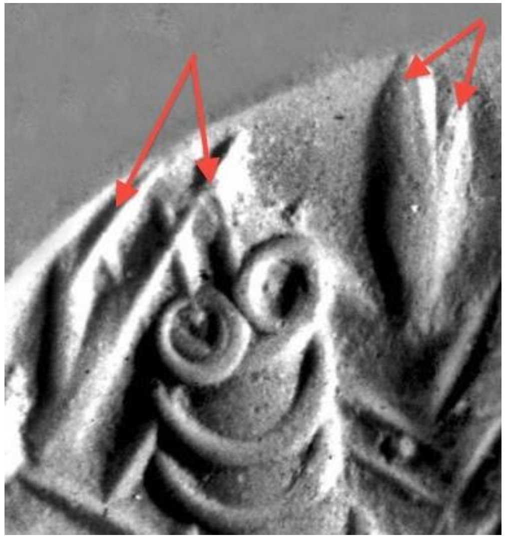


Fig. 7 The two pedipalps of the scorpion		Fig. 8 Two circles

	
Fig. 9 CMS XII No. 216 (JaCO No. 1)	Fig. 10 Impression

Chapter 4 - Plate 15

Composition: the motif of the forepart of fish

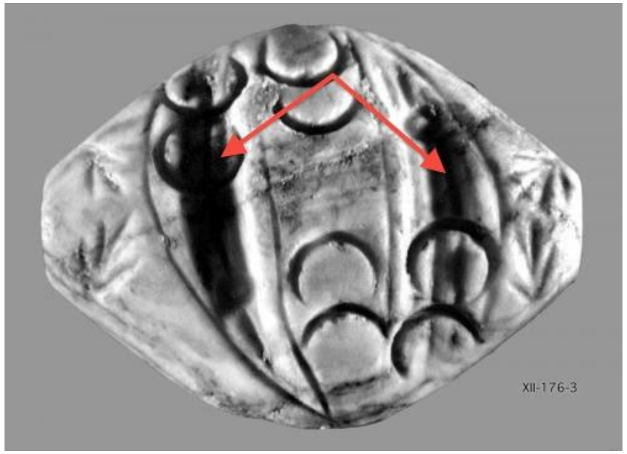


Fig. 1 Detail of the two deep cuts made by a broad wheel to create the forepart of fish.

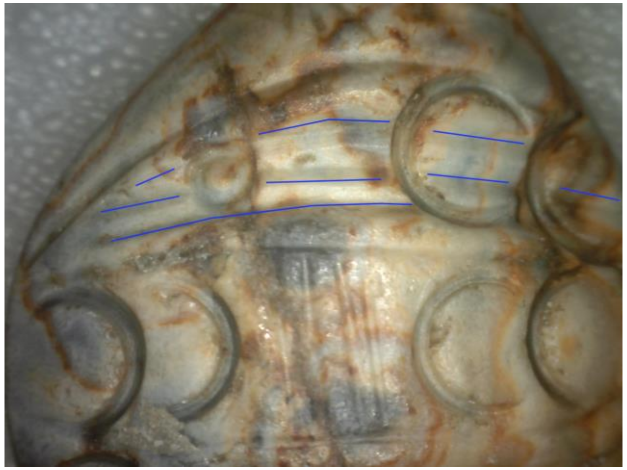


Fig. 2 Right side of the seal. Three visible lines overlapped on the first cuts

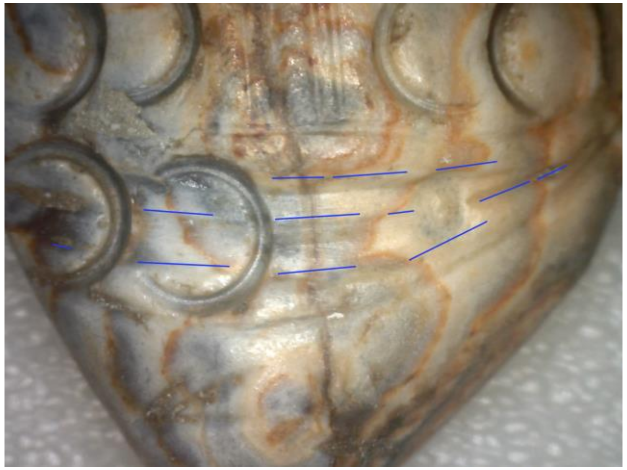


Fig. 3 Left side of the seal. Three visible lines overlapped on the first cuts

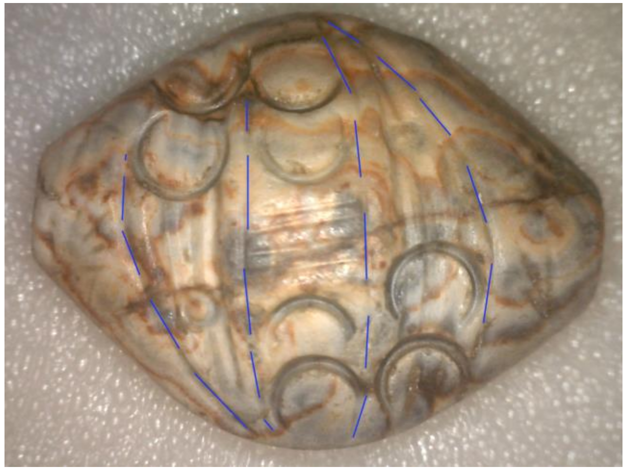


Fig. 4 Lines outlining the cuts previously made by the broad wheel		Fig. 5 Sequence of the disposition of the semicircles for each forepart of fish.

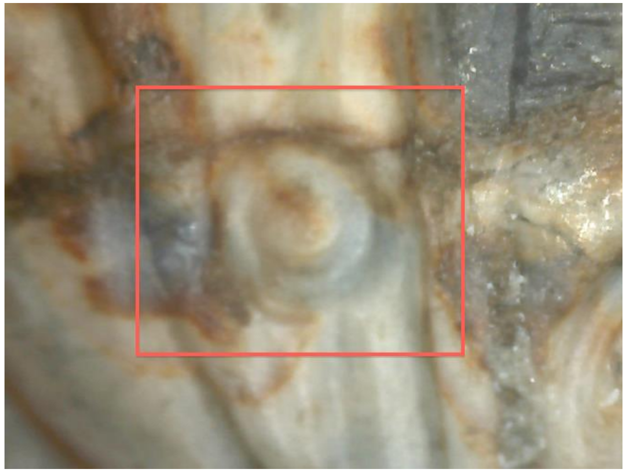
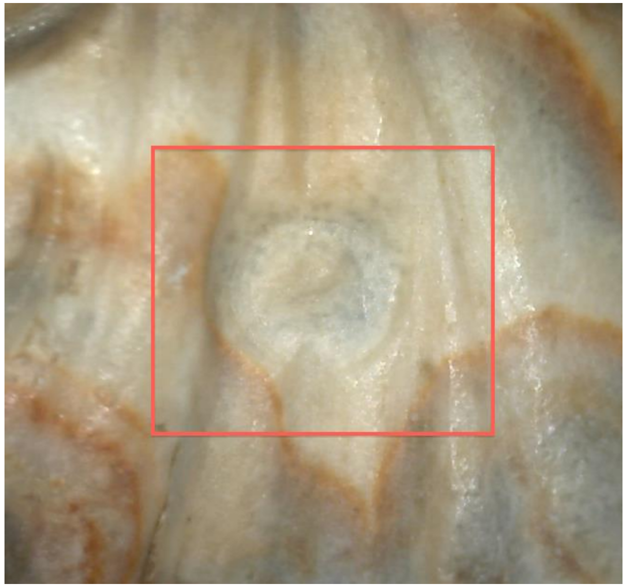
		

Fig. 6 Eye (disposed on the right figure) made by a tubular drill		Fig. 7 Eye (disposed on the left figure) made by a tubular drill

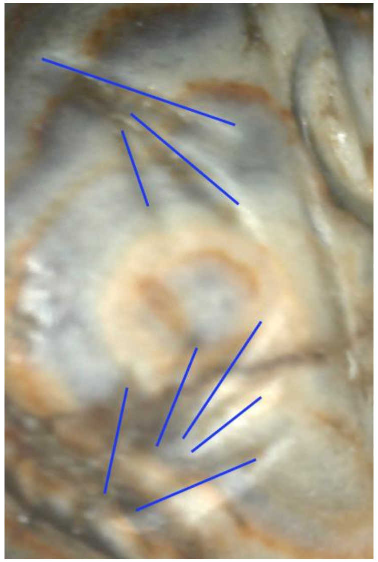


Fig. 8 Plants disposed on the left side

Fig. 9 Plants disposed on the right side

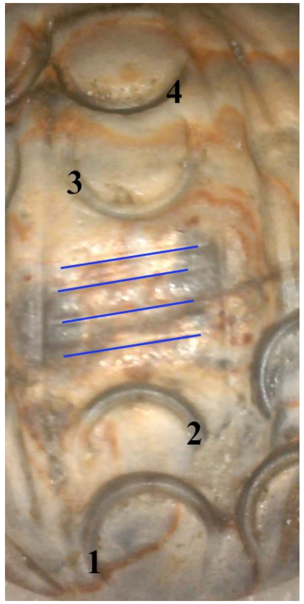


Fig. 10 Parallel lines disposed between the two figures

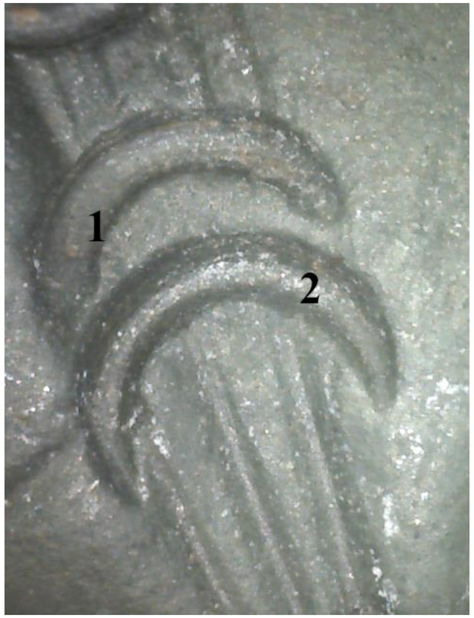
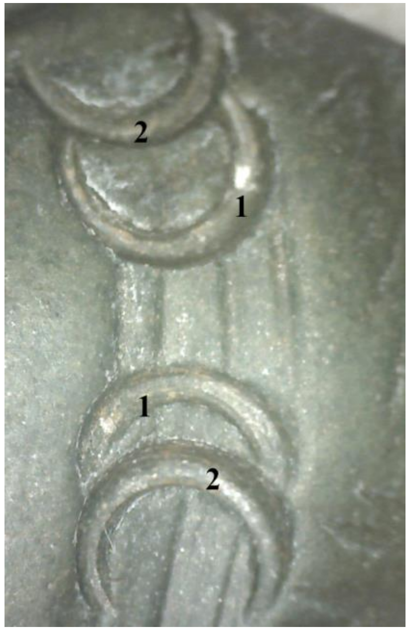
Fig. 11 CMS XII No. 176 (Ag No. 54)

Fig. 12 Impression

Chapter 4 - Plate 16

Composition: the motif of the v-shaped panel

Fig. 1 Two deep cuts made by the broad wheel	Fig. 2 Lines disposed on each panel.	Fig. 3 Detail of the semicircle disposed under the base of the figure

		
Fig. 4 Semicircles disposed on the two panels by a tubular drill.	Fig. 5 Detail: the sequence of the cuts disposition on the lower left figure.	Fig. 6 Detail: the sequence of the cuts disposed on the right figure.

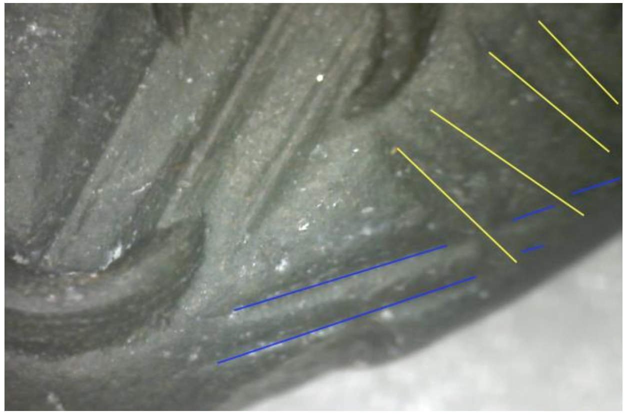
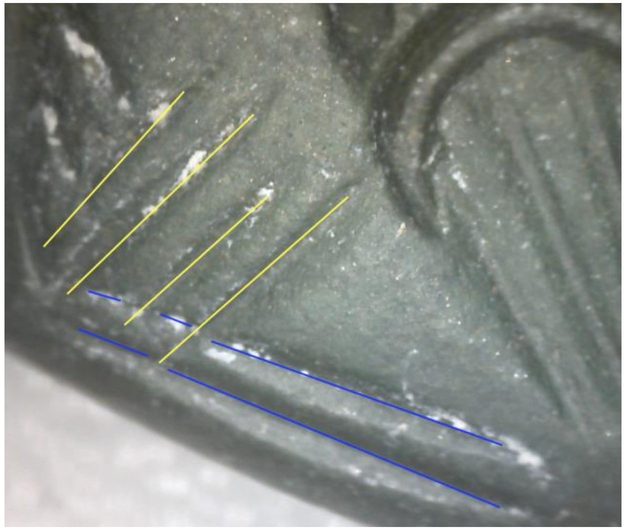
		

Fig. 7 Six lines disposed on the lower right of the figure. The blue lines have been engraved first		Fig. 8 Six lines disposed on the lower left of the figure. The blue lines have been engraved first

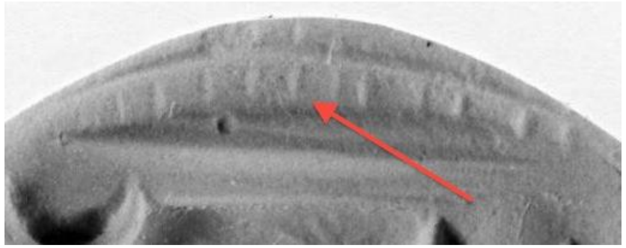
		
Fig. 9 Three lines disposed at the top of the figure		Fig. 10 Detail visible on the impression: twelve little cuts

		
Fig. 11 Cross-hatching composed by five lines	Fig. 12 Detail of the deep cut made by a broad wheel	Fig. 13 Eight lines compose the plant disposed on the left side

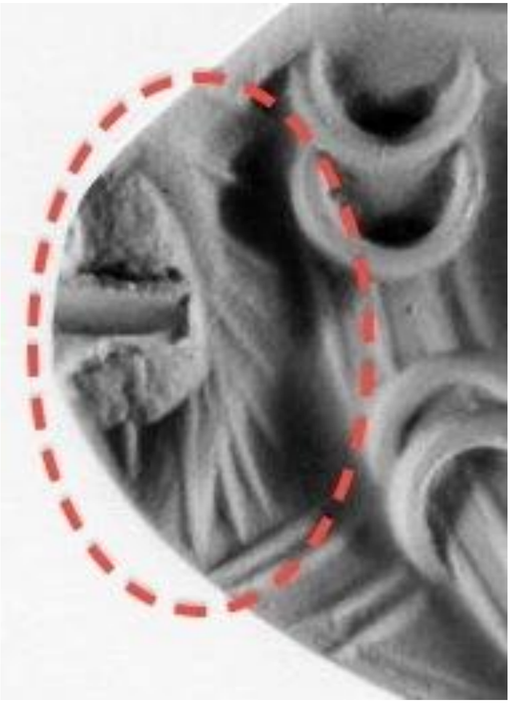


Fig. 14 Impression. Plant disposed on the right side of the seal surface		Fig. 15 Impression. Two straight lines disposed on either sides of the seal surface

Fig. 16 CMS XII No. 177 (UnS No. 45)

Fig. 17 Impression

Chapter 4 - Plate 17

Composition: the motif of the panel

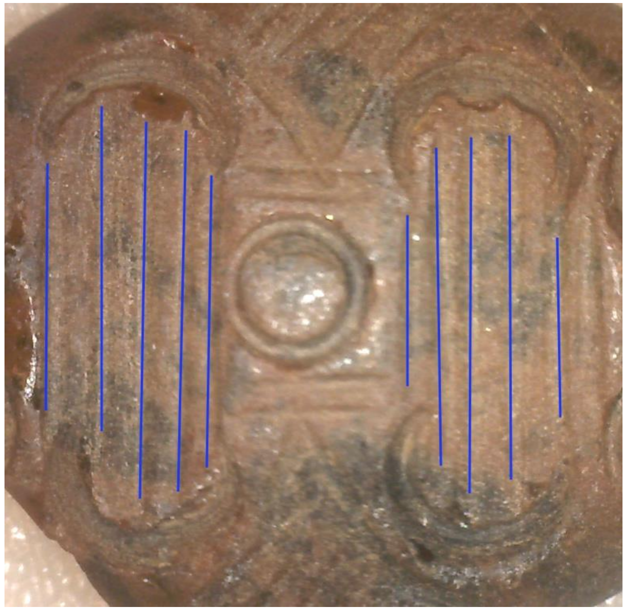
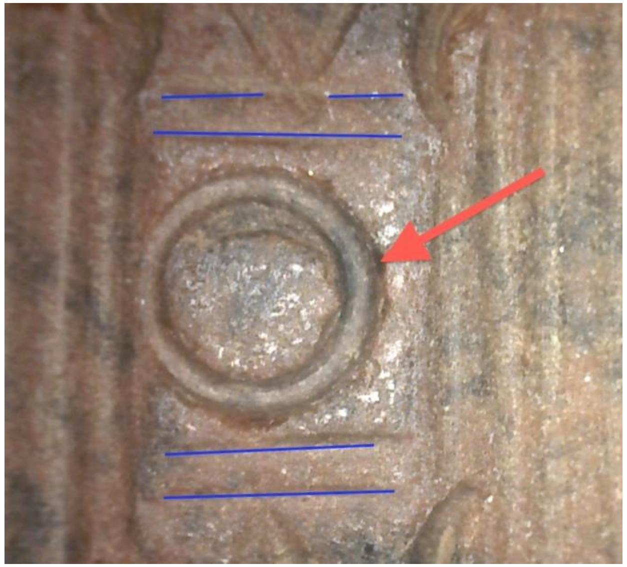
		

Fig. 1 Lines made by a thin wheel	Fig. 2 Semicircles	Fig. 3 Central pattern

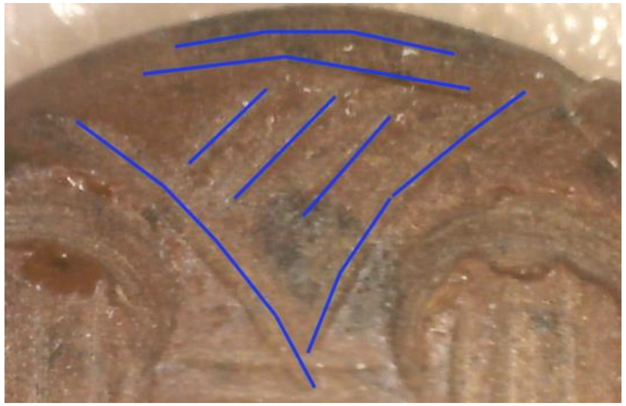
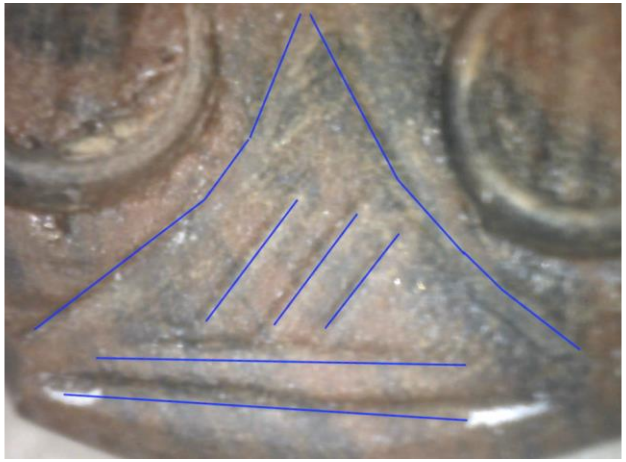
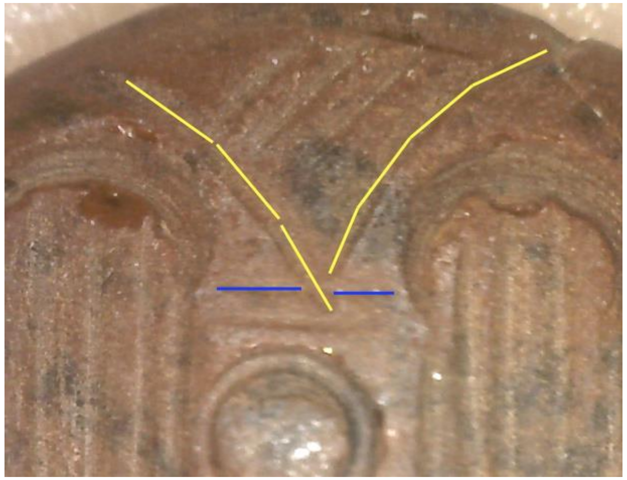
		

Fig. 4 Decoration disposed at the top of the seal surface	Fig. 5 Decoration disposed on the lower part of the seal surface	Fig. 6 The blue line has been engraved before the yellow ones

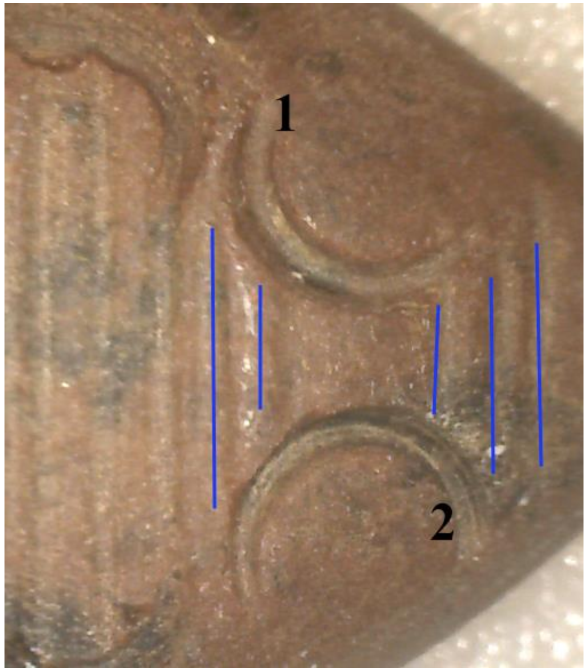
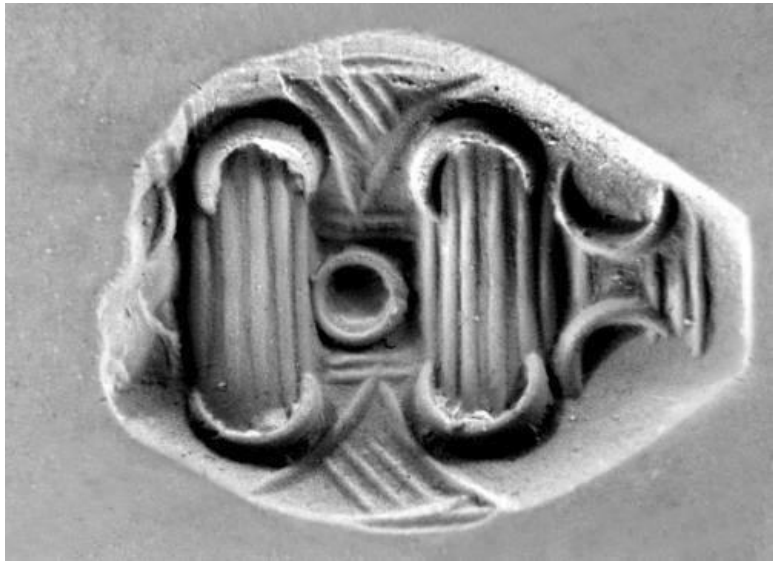


Fig. 7 Decoration disposed on the right side of the seal surface. It shows lines and the two semicircles.

Fig. 8 Traces of marks of a tubular drill

	
Fig. 9 CMS XII No. 192 (Ja No. 101)	Fig. 10 Impression

Chapter 4 - Plate 18

Composition: the motif of the panel

Second example

		
Fig. 1 CMS XII No. 171 (Qu No. 2)		Fig. 2

Chapter 4 - Plate 19

Composition: the motif of the double axe

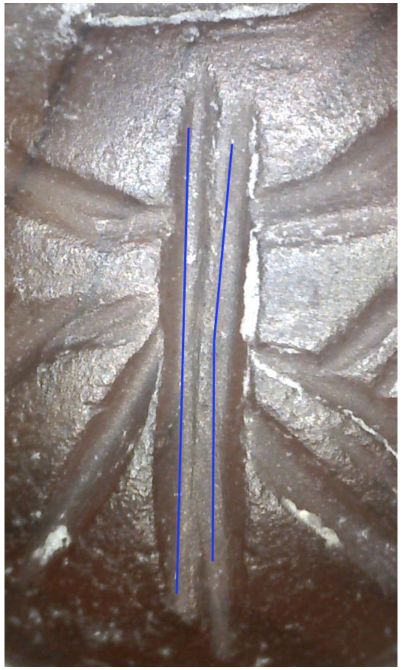
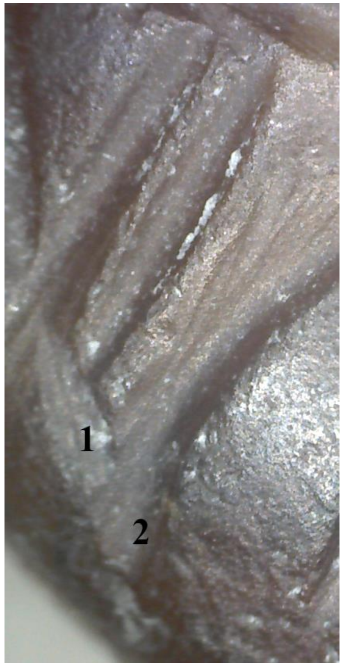
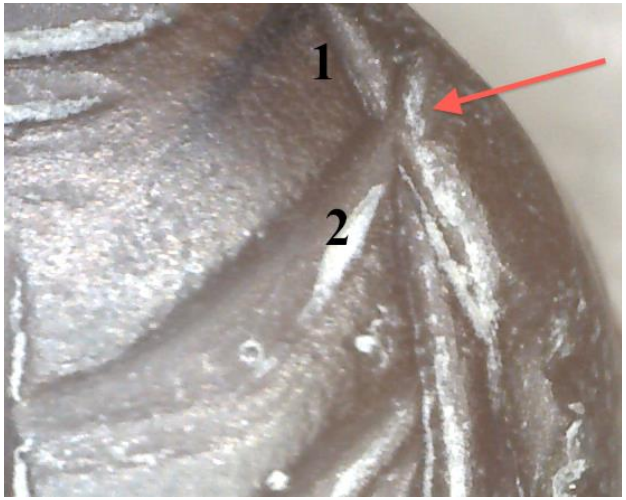
		

Fig. 1 Two lines made by a wheel	Fig. 2 Cuts overlapped on the lower left side of the seal surface	Fig. 3 Cuts overlapped on the upper right side of the seal surface

		
Fig. 4 The two cutting edges	Fig. 5 Creation of the 4 arches	Fig. 6 Three strokes of a cutting wheel can be seen

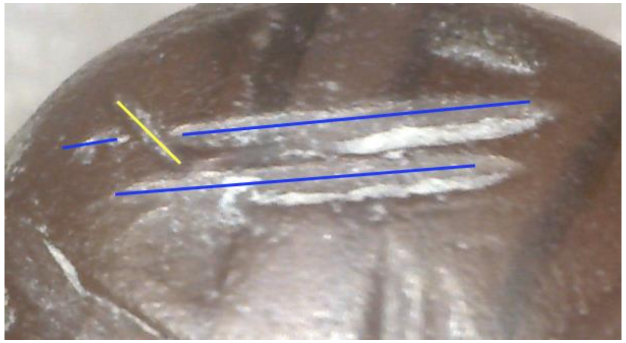
		
Fig. 7 Detail: little straight cuts which create the arch disposed on the bottom left of the seal surface	Fig. 8 Oblique lines as decoration	Fig. 9 Two parallel lines as decoration

	
Fig. 10 CMS XII No. 97 (Ca No. 253)	Fig. 11 Impression

Chapter 4 - Plate 20

Composition: the motif of the rosette

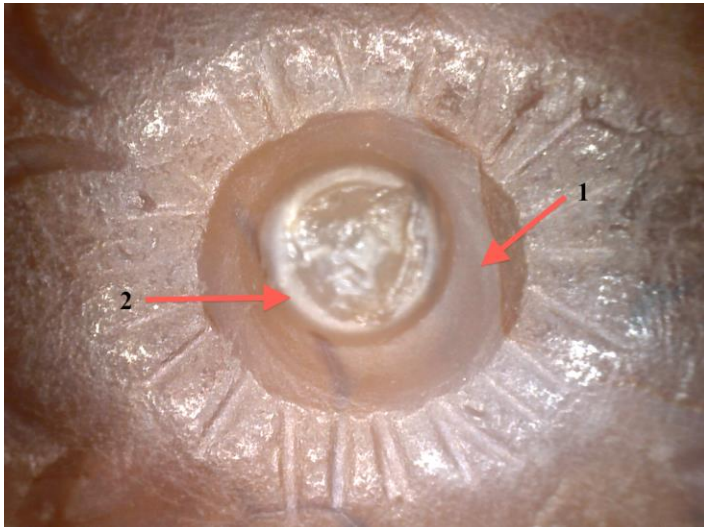
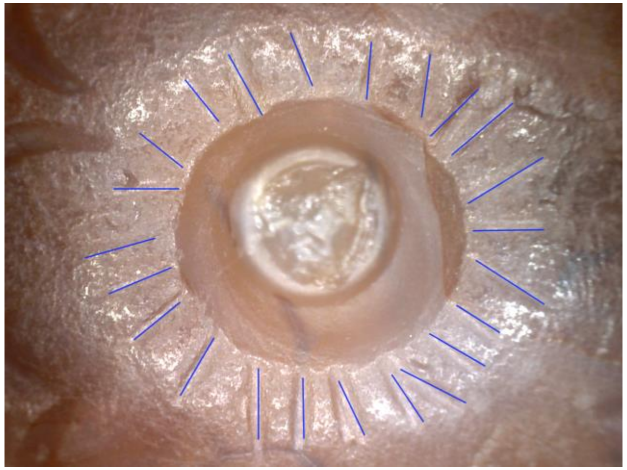
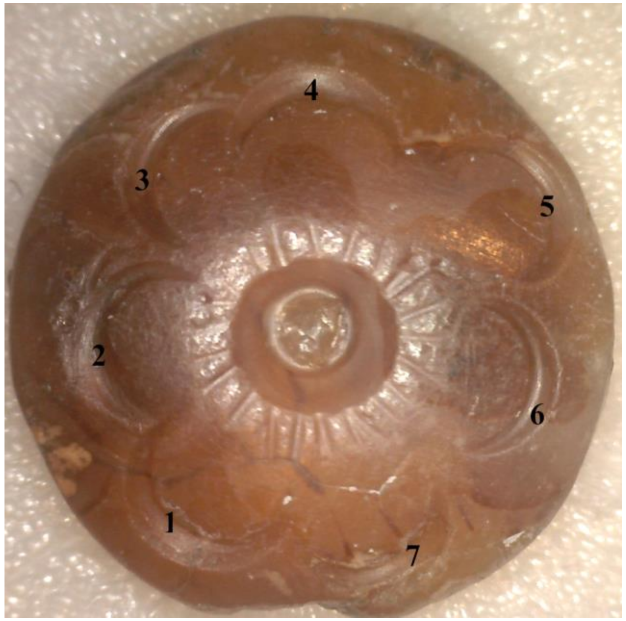


Fig. 1 Circle made by 1) a solid drill and 2) by a tubular drill overlapped		Fig. 2 Detail of the circle seen on the cast: 1) solid drill 2) tubular drill

<table>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>Fig. 3 Twenty-three straight lines cut surround the central circle</td><td></td><td>Fig. 4 Seven semicircles</td></tr>
</table>

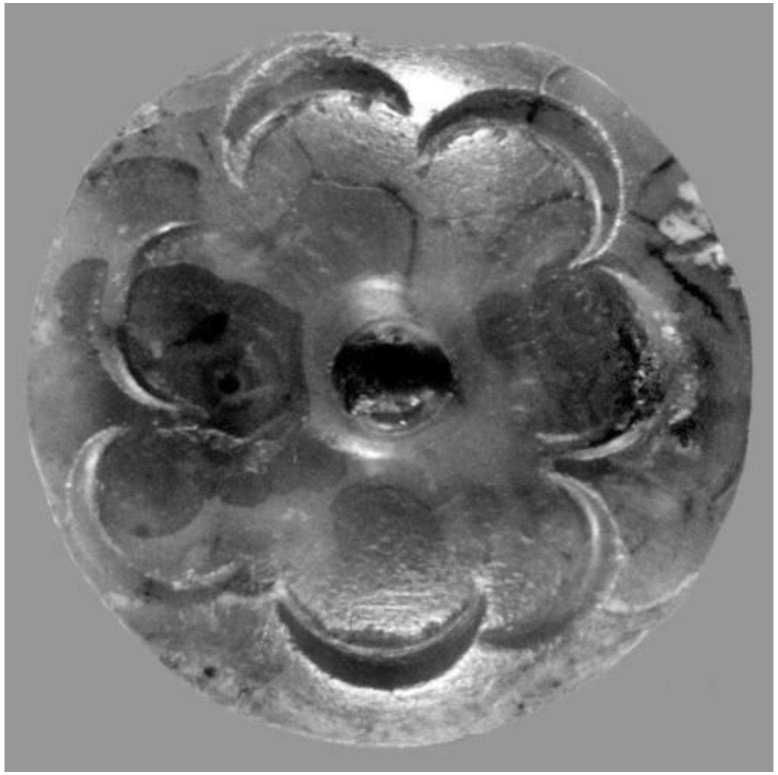


Fig. 5 CMS XII No. 157 (Ag No. 76)	Fig. 6 Impression

Chapter 4 - Plate 21

Composition: the motif of the triangle

		
Fig. 1 Three lines made by a cutting wheel	Fig. 2 Detail showing the presence of lines made by a thinner wheel on the previous cut disposed on the left side of the seal surface	Fig. 3 Detail showing the presence of lines made by a thinner wheel on the previous cut disposed on the right side of the seal surface

Fig. 4 Impression. The elongated line disposed on the right side

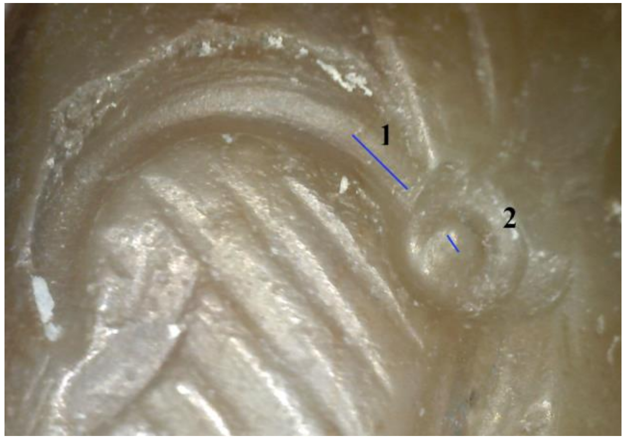
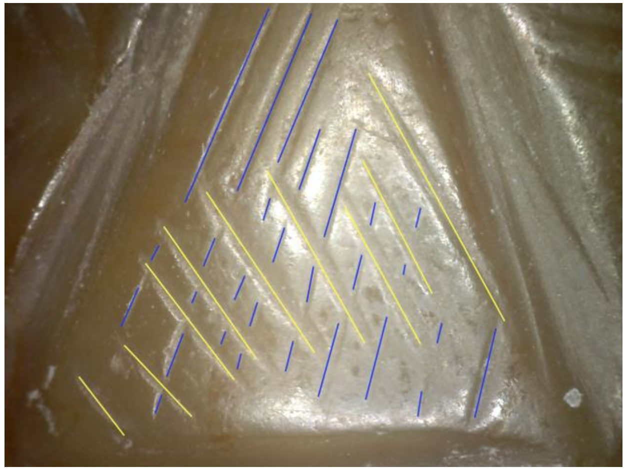


Fig. 5 Detail which shows the sequence of the cuts. The circle has been engraved after the semicircle

Fig. 6 Detail: five straight lines disposed under the left semicircle on the left side of the seal surface.

		
Fig. 7 Detail: lines disposed under the semicircle on the right side of the seal surface	Fig. 8 Cross-hatching creation: the blue lines have been engraved first.	Fig. 9 Semicircles disposed under the base line of the triangle

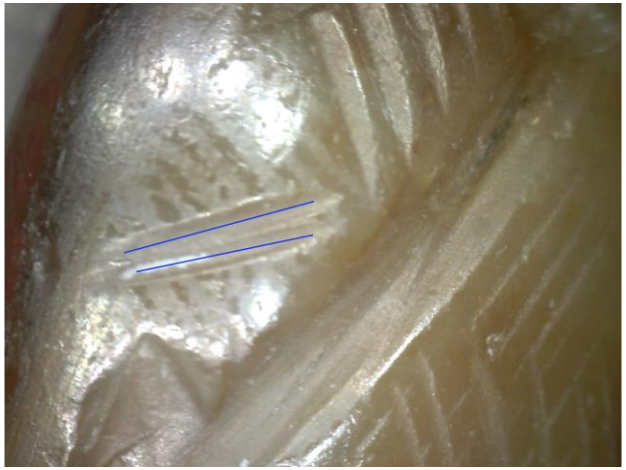
		
Fig. 10 Decorative lines		Fig. 11 Couple of lines disposed on the lefts side of the seal

		
Fig. 12 Couple of lines disposed on the right side of the seal		Fig. 13 Part of the seal damaged

	
Fig. 14 CMS XII No. 202 (Ca No. 269)	Fig. 15 Impression

Chapter 4 - Plate 22

Composition: the motif of the fish

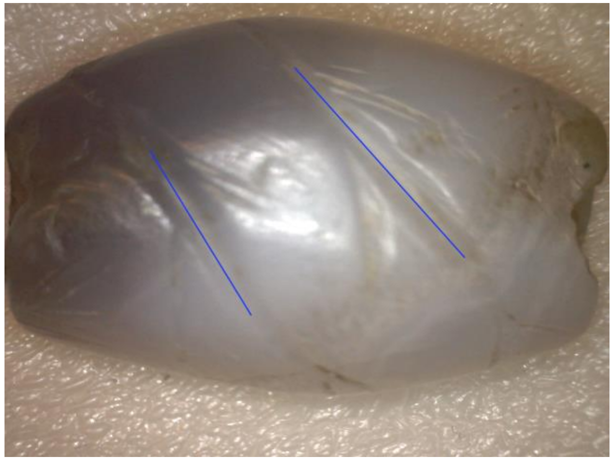
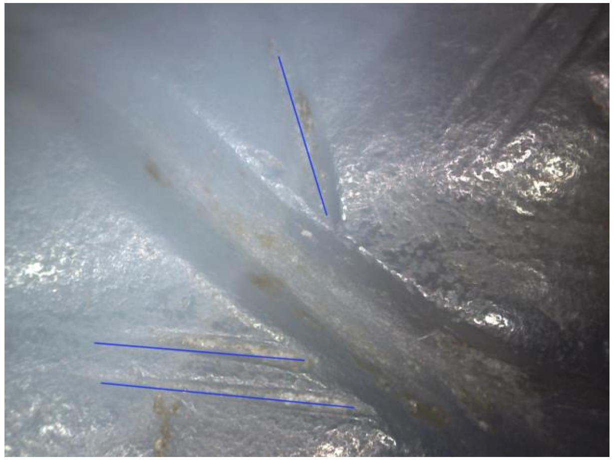
	

Fig. 1 Bodies of the two fish	Fig. 2 Fins of the fish disposed on the right side of the seal	Fig. 3 Fins of the fish disposed on the left side of the seal

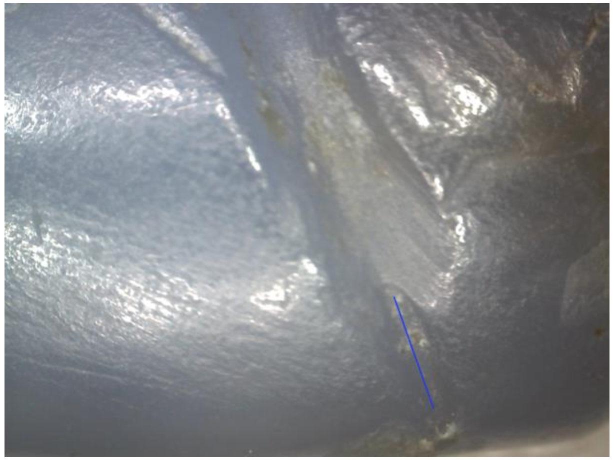
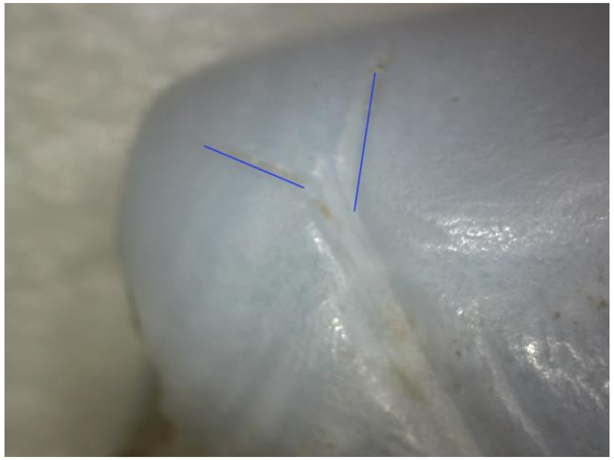
		

Fig. 4 The beak on the head of the fish disposed on the right side of seal	Fig. 5 Sort of beak on the head of the fish disposed on the left side of seal	Fig. 6 The tail of the fish disposed on the left side of the seal

		
Fig. 7 The tail of the fish disposed on the right side of the seal		Fig. 8 Elongated fin of the fish disposed on the left side of the seal.

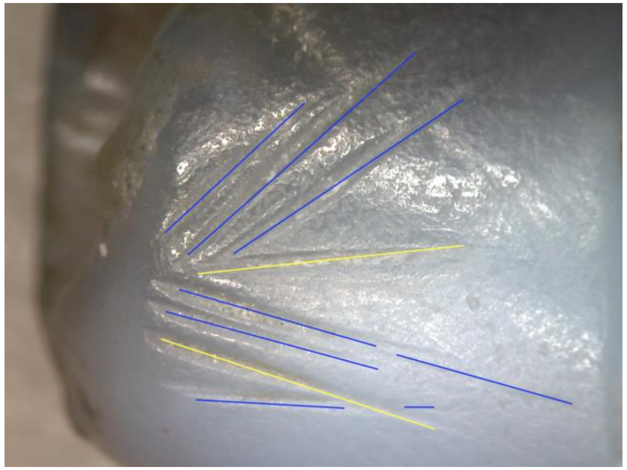


Fig. 9 Plant disposed on the left side of the seal surface. The blue lines have been engraved first.		Fig. 10 Plant disposed on the right side of the seal surface. The blue lines have been engraved first.

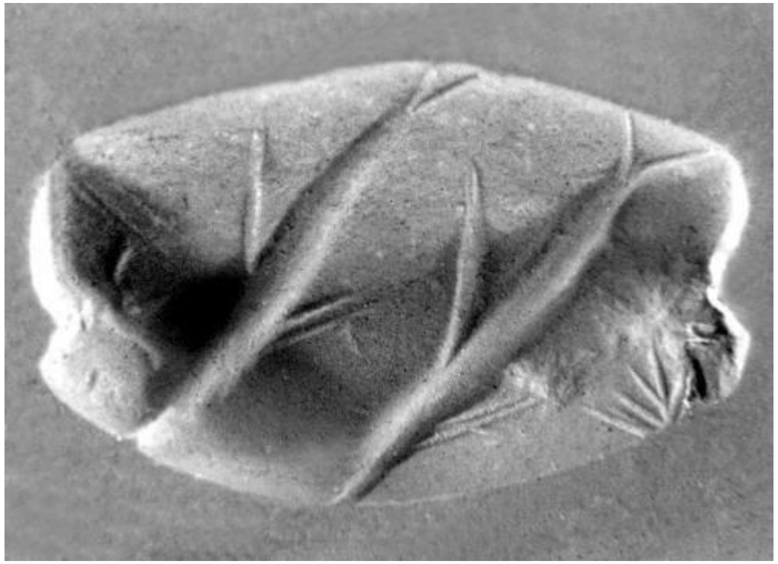


Fig. 11 CMS XII No. 190 (Ag No. 86)	Fig. 12 Impression

Chapter 4 - Plate 23

Technical observations

Fig. 1 CMS XII No. 143 (Ca No. 11) Handle created by the S-shaped cut for the motif of the amphora.

Fig. 2 CMS V No. 207 (Ca No. 40) Handle created by the S-shaped cut for the motif of the jug.

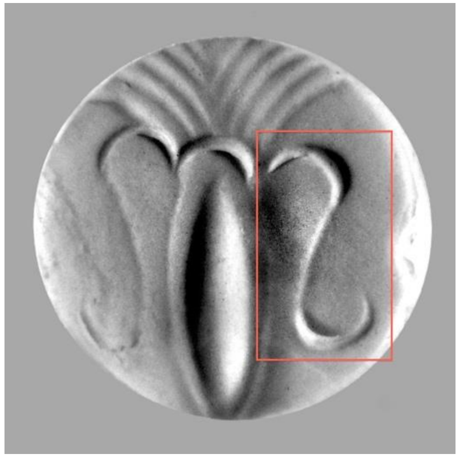


Fig. 3 CMS XII No. 152 (Ja No. 40) Fin of a cuttlefish made though the S-shaped cut.

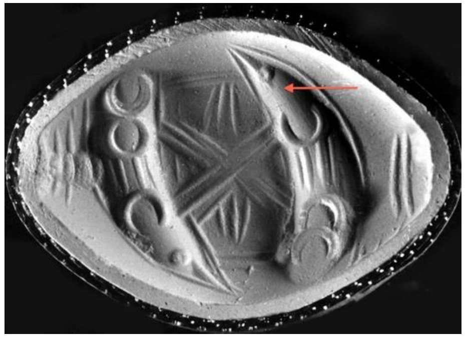
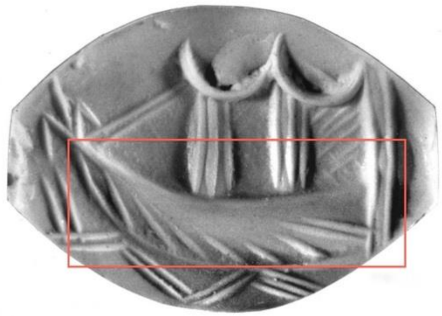
			

Fig. 4 CMS VI No. 230 (Ag No. 53). Cut made by the broad wheel	Fig. 5 CMS IV No. 215 (Ca No. 42). Cut made by the broad wheel	Fig. 6 CMS VII No. 76 (Ca No. 189). Cut made by the broad wheel	Fig. 7 CMS II, 3 No. 361 (Ca No. 107). Cut made by the broad wheel

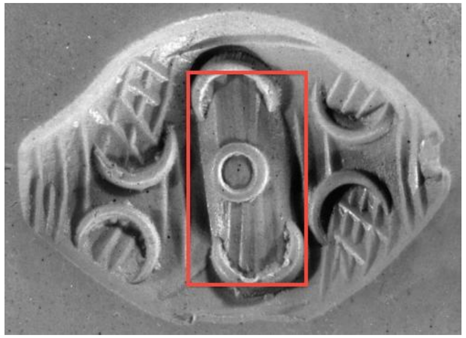
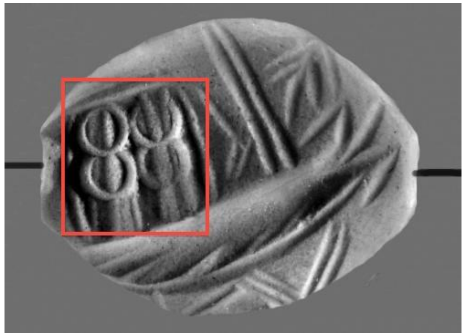
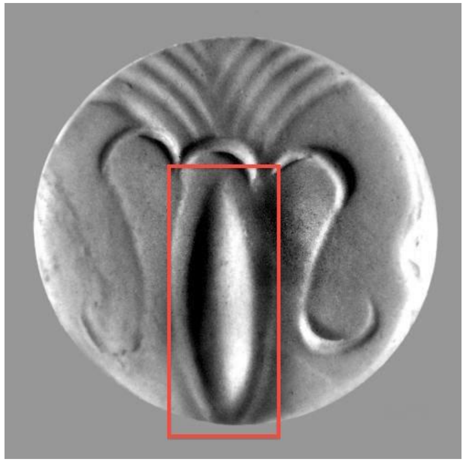
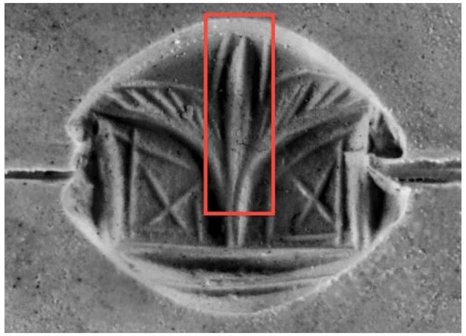
			

Fig. 8 CMS X No. 107 (Ca No. 235). Stocky cut made by the broad wheel	Fig. 9 CMS VII No. 227 (Ca No. 86). Stocky cut made by the broad wheel	Fig. 10. Elongated cut made by the wheel	Fig. 11 CMS VII No. 226 (Ca No. 115). Elongated cut made by the wheel

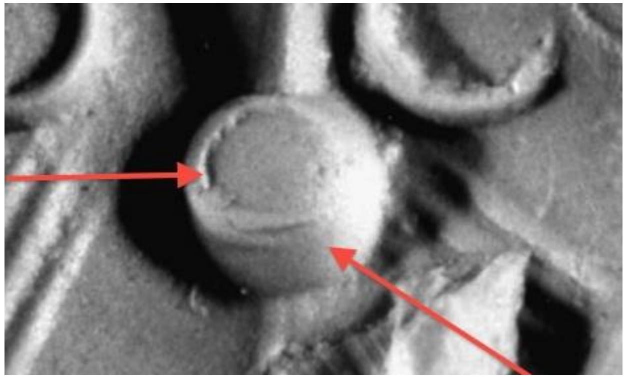
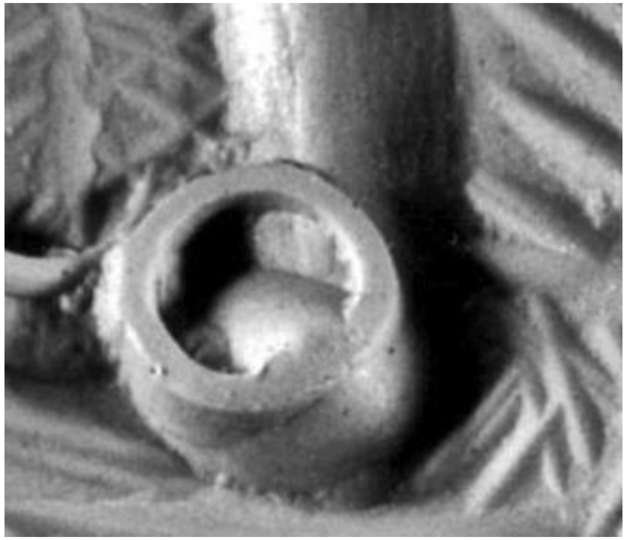
		

Fig. 12 Detail visible on the impression. The detail shows the use of the drills overlapped. A plastic ring is overlapped on a plastic bubble.	Fig. 13 CMS III No. 253 (Ca No. 37) the detail shows the combination of both solid and tubular drills on the impression. The two tools have not been symmetrically juxtaposed.	Fig. 14 CMS XI No. 276 (Ca No. 49) the detail shows the combination of solid and tubular drills on the impression. The two tools have been juxtaposed not symmetrically.

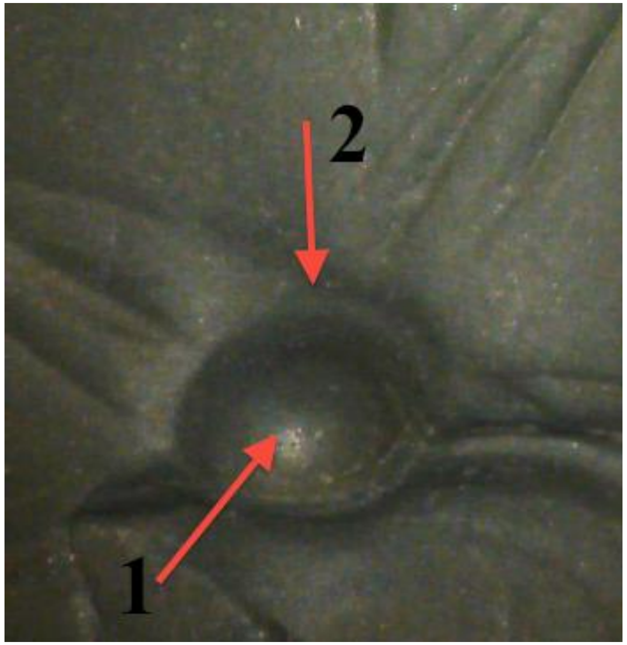
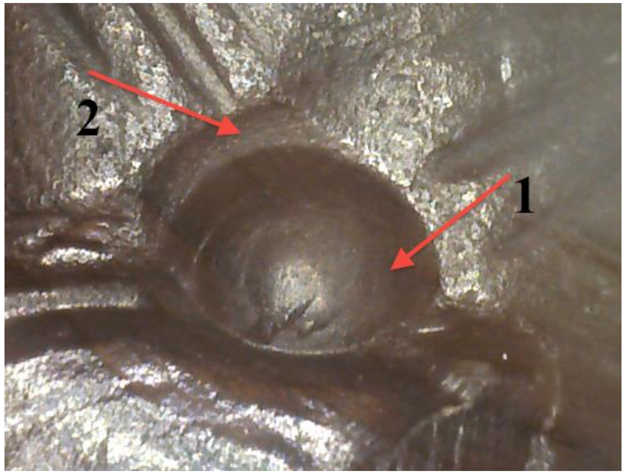
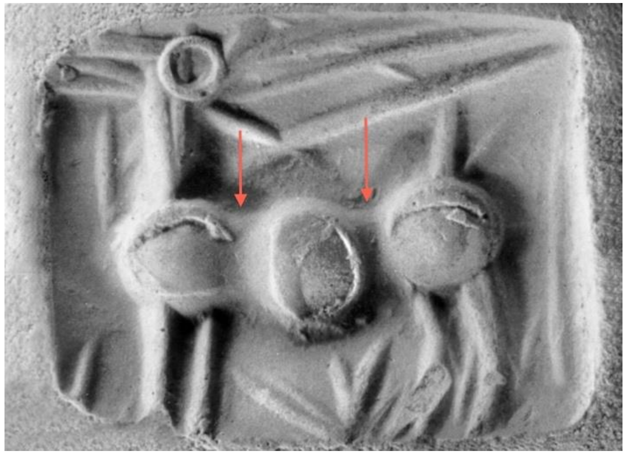
		

Fig. 15 CMS XII No. 193 (AgCO No. 4). The detail on the impression shows the bubble surrounded by a plastic ring	Fig. 16 CMS XII No. 193 (AgCO No. 4). Real seal: traces of tubular drill (2) and solid drill (1)	Fig. 17 Visible guidelines made by a cutting wheel

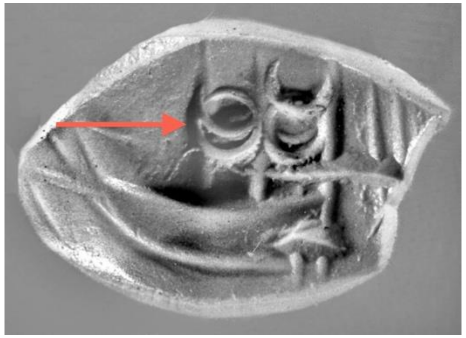
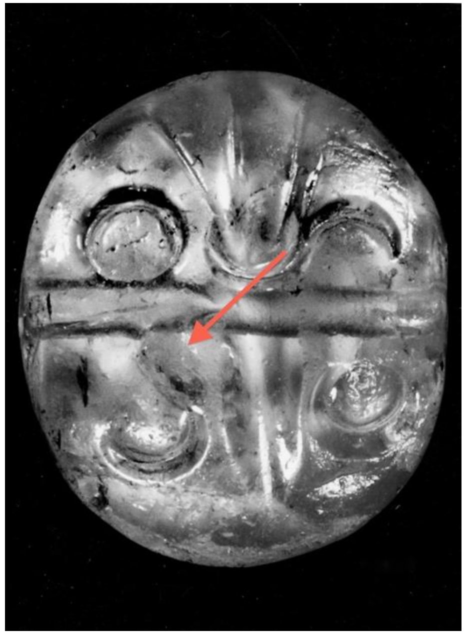
			

Fig. 18 CMS IX No. 92c (Ag No. 27). Imprecisions can be seen for the use of the tubular drill	Fig. 19 CMS IX No. 92c (Ag No. 27). Real seal: banded agate	Fig. 20 CMS III No. 285 (Gl No. 1) Imprecision can be seen for the inter-connective line between the two semicircles	Fig. 21 CMS III No. 285 (Gl No. 1). Real seal: transparent material

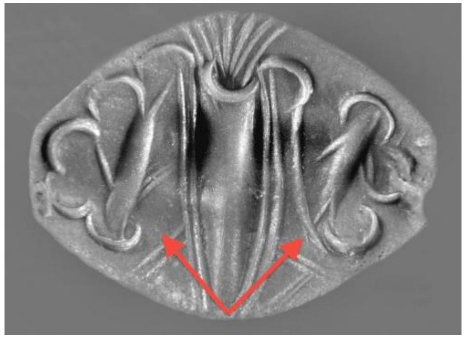
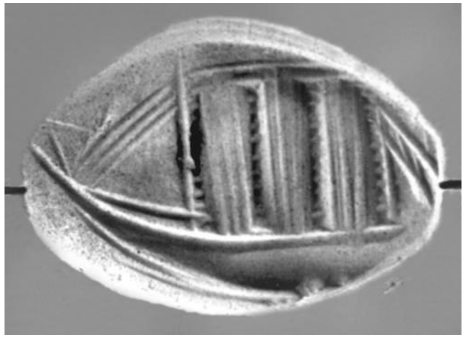
			

Fig. 22 CMS VIII No. 62 (AgCo No. 7). Mistakes visible for the juxtaposition of the S-shape cut	Fig. 23 CMS IV No. 225 (Ca No. 298). Impression: imprecision for the creation of the talismanic wild goat	Fig. 24 CMS IV No. 225 (Ca No. 298). Real seal: imprecision for the creation of talismanic wild goat	Fig. 25 CMS I No. 436b (Ca No. 327) An example of a good manufacture
			
Fig. 26 CMS VII No. 104 (Ca No. 92). An example of a good manufacture			

Chapter 4, Plate 24

The Cut Style

Birds antithetically disposed

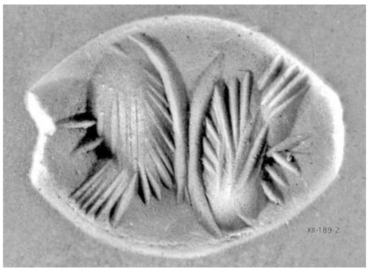
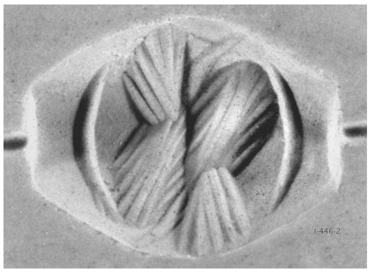
		

Fig. 1 CMS XII No. 189 (Agate)	Fig. 2 CMS II, 3 No. 357 (Hematite)	Fig. 3 CMS I No. 446 (Carnelian)

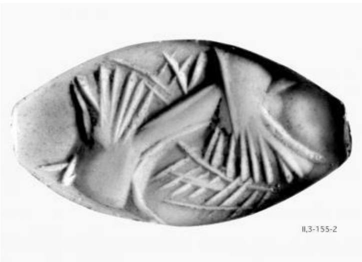



Fig. 4 CMS II, 3 No. 155 (Carnelian)	Fig. 5 **CMS II, 3 No. 254b** (Carnelian)	Fig. 6 HM 2616 (Hematite) (see Catling et al. 1979, p. 66, Fig. 14)

Chapter 4, Plate 25

The Cut Style

Profiled birds

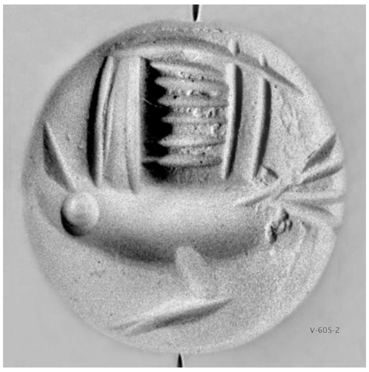
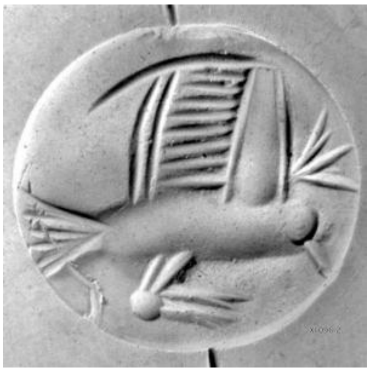
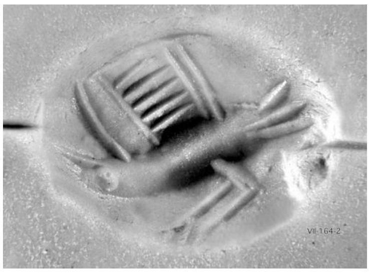
		

Fig. 1 CMS V No. 605 (Carnelian)	Fig. 2 CMS XI No. 96 (Carnelian)	Fig. 3 CMS VII No. 164 (Rock Crystal)

Chapter 4, Plate 26

The Cut Style

Birds with fully outspread wings

		
Fig. 1 CMS IV No. 260 (Hematite)	Fig. 2 **CMS XII No. 162b** (Unclear stones)	Fig. 3 CMS III, 2 No. 487 (Unclear stone)

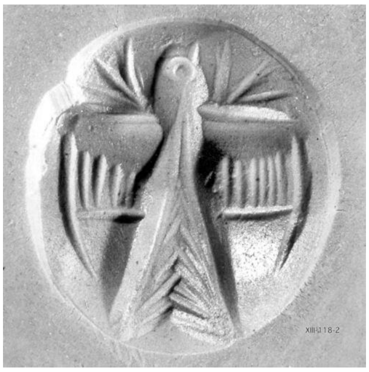
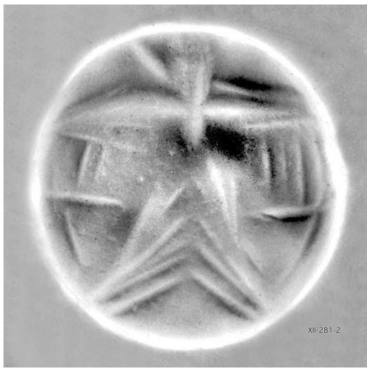

		

Fig. 4 CMS XIII No. 118 (Agate)	Fig. 5 CMS III No. 488 (Carnelian)	Fig. 6 CMS XII No. 281 (Schist)

		
Fig. 7 CMS II, 3 No. 354 (Jasper)	Fig. 8 CMS VII No. 259 (Carnelian)	Fig. 9 CMS VIII No. 57 (Agate)

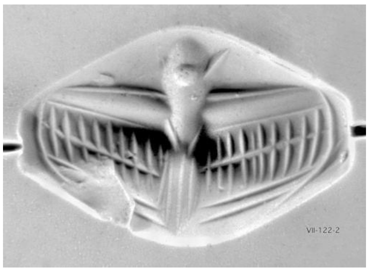



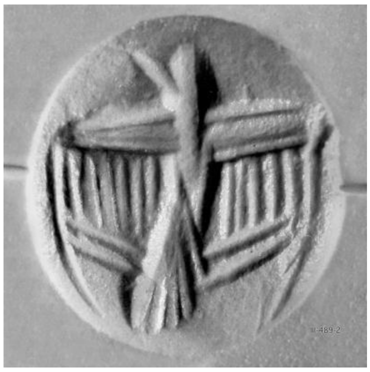
Fig. 10 CMS VII No. 122 (Unclear stone)	Fig. 11 CMS II, 3 No. 355 (Unclear stone)	Fig. 12 CMS II, 3 No. 194 (Unclear stone)
		
Fig. 13 CMS II, 3 No. 94 (Unclear stone)	Fig. 14 CMS II, 3 No. 132 (Unclear stone)	Fig. 15 CMS III No. 489 (Unclear stone)

		
Fig. 16 HM 2323 (Hematite) (Sackett & Popham 1970, Pl. 1, no. 55)	Unknown Onassoglou p. 270 No. 28	

Chapter 4, Plate 27

The Cut Style

Birds with bent outspread wings

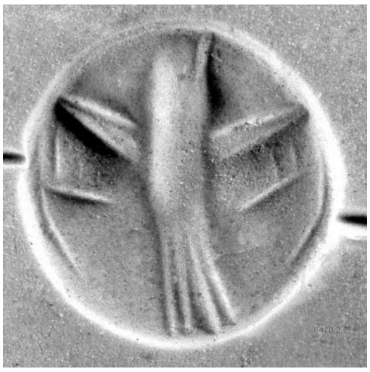
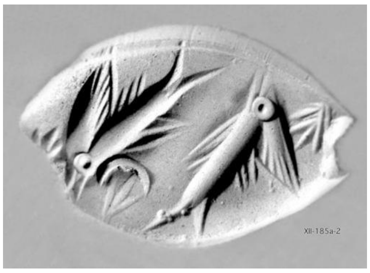
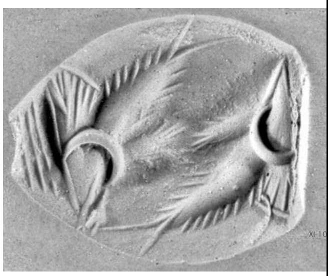
		
Fig. 1 CMS X No. 318 (Carnelian)	Fig. 2 CMS VIII No. 155 (Carnelian)	Fig. 3 CMS VIII No. 158 (Carnelian)
		
Fig. 4 **CMS X No. 277b** (Carnelian)	Fig. 5 **CMS II, 3 No. 254a** (Carnelian)	Fig. 6 CMS VI No. 273 (Amethyst)
		

Fig. 7 CMS I No. 146 (Glass)	Fig. 8 CMS VII No. 69 (Hematite)	Fig. 9 CMS I No. 470 (Hematite)
		
Fig. 10 CMS II, 3 No. 181 (Serpentine)	Fig. 11 CMS III No. 490 (Steatite)	Fig. 12 CMS IX No. 62 (Unclear stone)

Chapter 4, Plate 28

The Cut Style

Fish antithetically disposed

		
Fig. 1 CMS IV No. 169 (Ag No. 87)	Fig. 2 CMS IV No. 172 (Ag No. 89)	Fig. 3 **CMS XII No. 185a** (Ca No. 319)
		
Fig. 4 CMS V No. 179 (Ca No. 318)	Fig. 5 CMS XI No. 109 (Ca No. 320)	Fig. 6 CMS IX No. 72 (UnS No. 73)

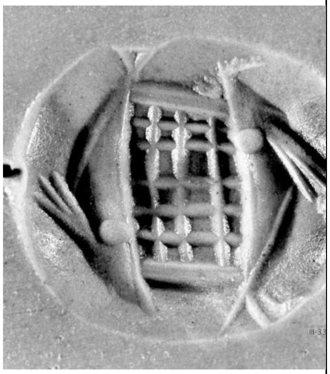
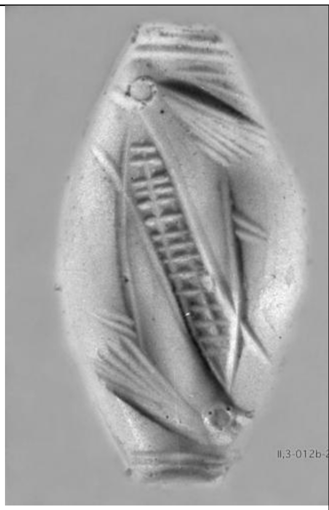
	

Fig. 7 CMS III No. 336 (Ca No. 334)	Fig. 8 **CMS II, 3 No. 12b** (Ca No. 339)	Fig. 9 CMS IX No. 60 (UnS No. 82)

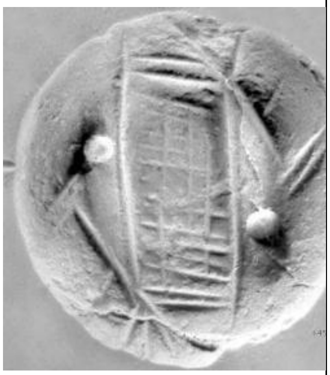
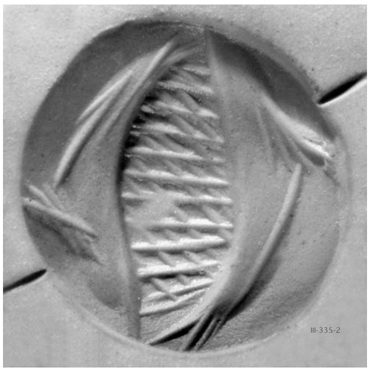
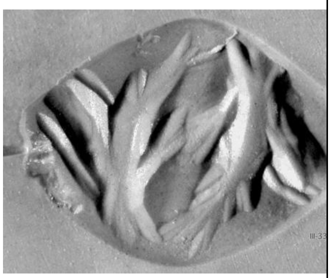
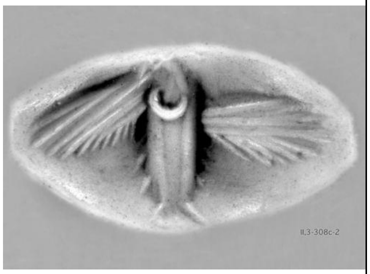

		

Fig. 10 CMS I No. 457 (PsJa No. 5)	Fig. 11 CMS II, 6 No. 133 (Sls No. 16)	Fig. 12 CMS III No. 335 (Ca No. 333)
		
Fig. 13 CMS IV No. 187 (RoCry No. 31)	Fig. 14 CMS III No. 334 (Am No. 10)	Fig. 15 CMS X No. 116 (UnS No. 85)

Chapter 4, Plate 29

The Cut Style

Fish in a frontal pose

		
Fig. 1 CMS XIII No. 143 (Ag No. 82)	Fig. 2 CMS II, 3 No. 308c (Ag No. 95)	Fig. 3 CMS VI No. 249 (RoCry No. 25)

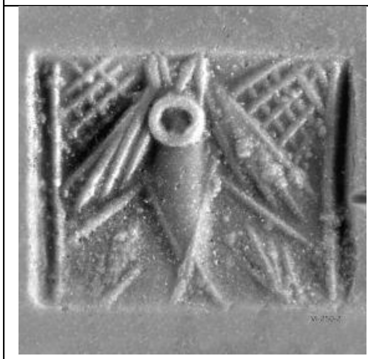
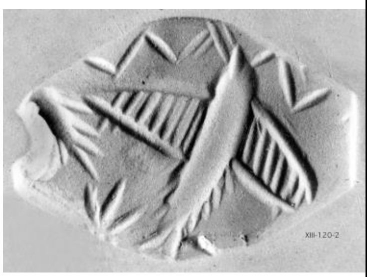
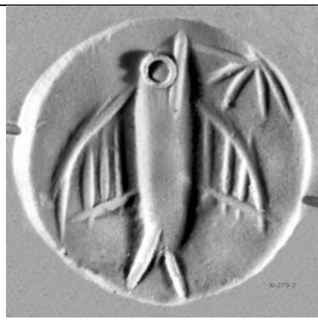



Fig. 4 CMS VI No. 250 (He No. 9)	Fig. 5 CMS IX No. 57 (Ag No. 92)	Fig. 6 CMS XIII No. 119 (Ca No. 305)
		
Fig. 7 CMS XII No. 150b (Ca No. 311)	Fig. 8 CMS XIII No. 120 (Cha No. 12)	Fig. 9 CMS XI No. 279 (UnS No. 87)

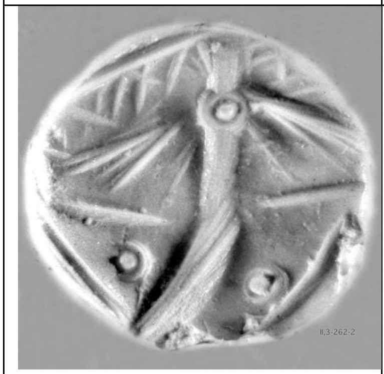
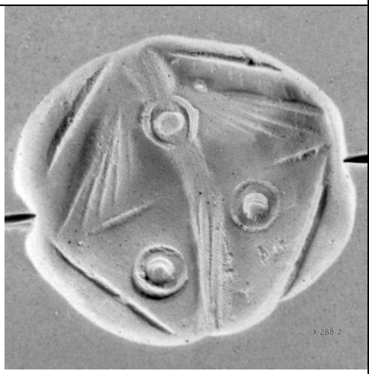
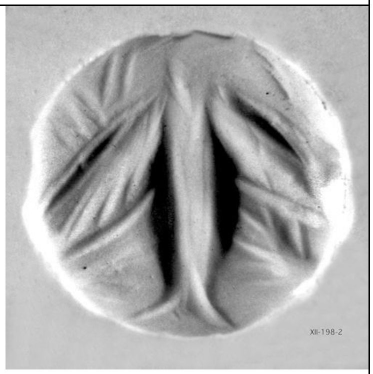
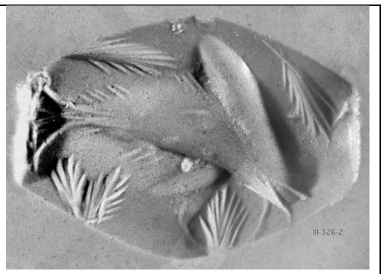
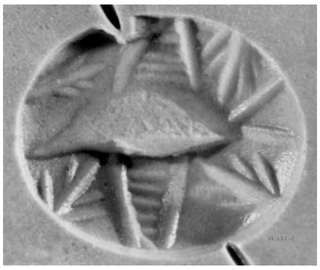
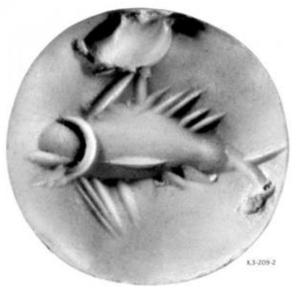
		

Fig. 10 CMS II, 3 No. 262 (Ser No. 11)	Fig. 11 CMS X No. 288 (UnS No. 80)	Fig. 12 CMS XII No. 198 (RoCry 198)

Chapter 4, Plate 30

The Cut Style

Fish in a profiled pose

		
Fig. 1 CMS I No. 436c (Ca No. 327)	Fig. 2 CMS II, 3 No. 375 (Ca No. 337)	Fig. 3 CMS III, 2 No. 326 (UnS No. 84)
		
Fig. 4 CMS II, 3 No. 34 (Ja No. 131)	Fig. 5 CMS III, 2 No. 331(Ja 136)	Fig. 6 CMS II, 3 No. 209 (RoCry No. 29)
		
Fig. 7 CMS I No. 409 (Ca No. 310)	Fig. 8 CMS X No. 94 (RoCry No. 28)	Fig. 9 CMS XII No. 186a (Ca No. 323)

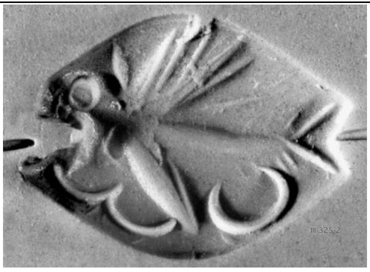
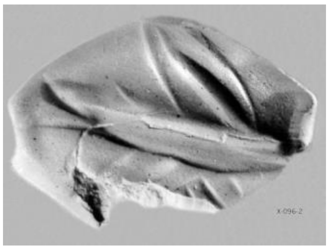
		

Fig. 10 CMS III, 2 No. 325 (Ca No. 329)	Fig. 11 CMS IX No. 59 (Ag No. 91)	Fig. 12 CMS X No. 96 (Ja No. 128)

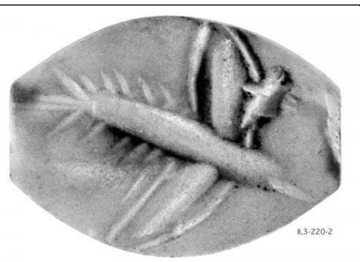
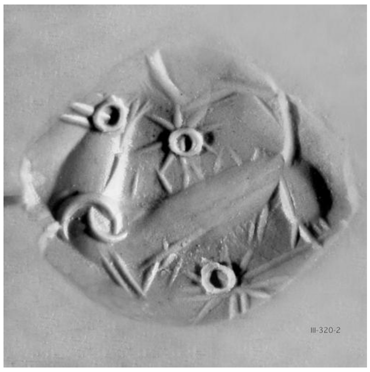



Fig. 13 CMS II, 3 No. 220 (RoCry No. 23)		

Chapter 4, Plate 31

Other cut style motifs

		
Fig. 1 **CMS VI No. 106d** (Carnelian)	Fig. 2 CMS II, 3 No. 292 (Chalcedony)	Fig. 3 CMS III, No. 320 (Carnelian)

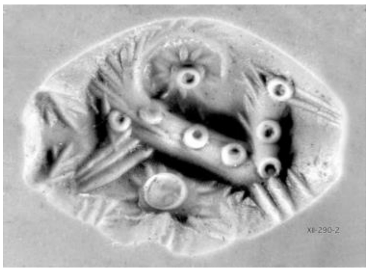
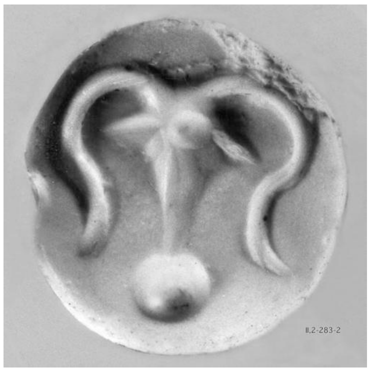

		

Fig. 4 CMS XII No. 290 (Carnelian)	Fig. 5 CMS VII No. 34 (Jasper)	Fig. 6 CMS II, 2 No. 283 (Rock Crystal)

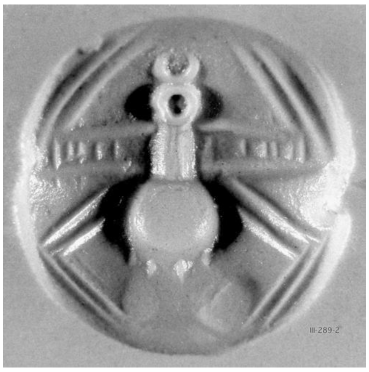
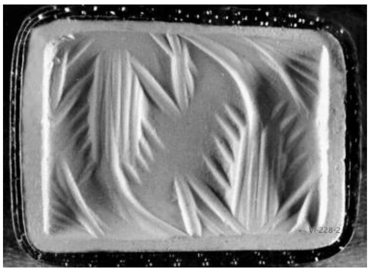
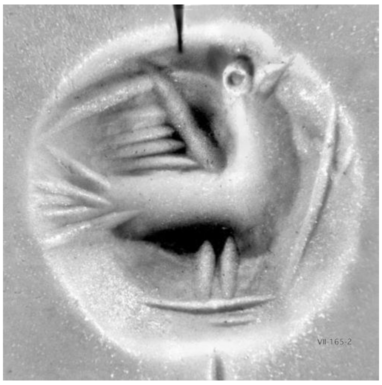
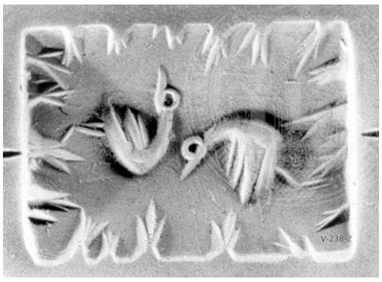
	

Fig. 7 CMS III, 2 No. 289 (Carnelian)	Fig. 8 CMS VI No. 228 (Carnelian)	

Chapter 4, Plate 32

Naturalistic birds

		
Fig. 1 CMS VII No. 44 (Agate)	Fig. 2 CMS VII No. 165 (Carnelian)	Fig. 3 CMS V No. 238 (Unclear stone)
		
Fig. 4 CMS II, 3 No. 180 (Chalcedony)	Fig. 5 **CMS VI No. 257b** (Agate)	Fig. 6 CMS I No. 150 (Agate)

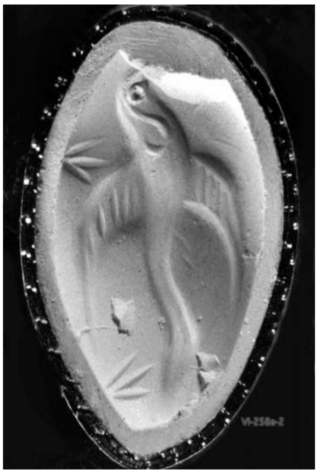


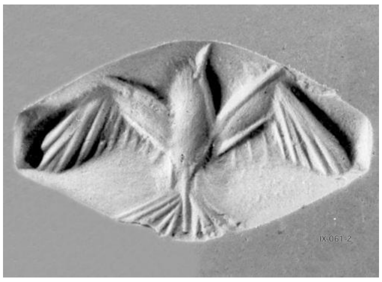
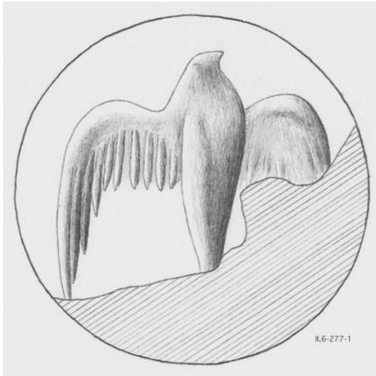
Fig. 7 CMS VI No. 258 (Carnelian)	Fig. 8 XII No. 141 (Carnelian)	Fig. 9 **XII No. 150a** (Carnelian)
		
Fig. 10 CMS II, 3 No. 232 (Carnelian)	Fig. 11 CMS II, 3 No. 269 (Carnelian)	Fig. 12 CMS IX No. 61 (Jasper)
		

Fig. 13 CMS IV no. 257 (Jasper)	Fig. 14 Sealing CMS II, 6 No. 116	Fig. 15 Sealing CMS I No. 213
		
Fig. 16 Sealing CMS II, 6 No. 123	Fig. 17 Sealing CMS VS1A No. 165	Fig. 18 Sealing CMS II, 6 No. 277

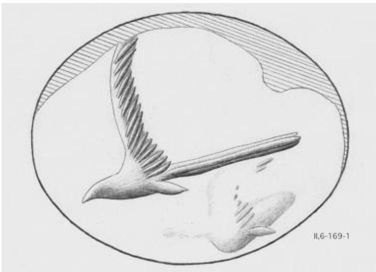



Fig. 19 Sealing CMS II, 6 No. 169	Fig. 20 HM 1034, ring (gold) (Popham, Catling & Catling, 1974, 217, Pl. 37 Fig. 14 a-c.)	Fig. 21 ring CMS II, 3 No. 114 (gold)

		
Fig. 22 CMS II, 2 No. 43 (Alloy)	Fig. 23 CMS III No. 495 (Carnelian)	

Chapter 4, Plate 33

Naturalistic fish

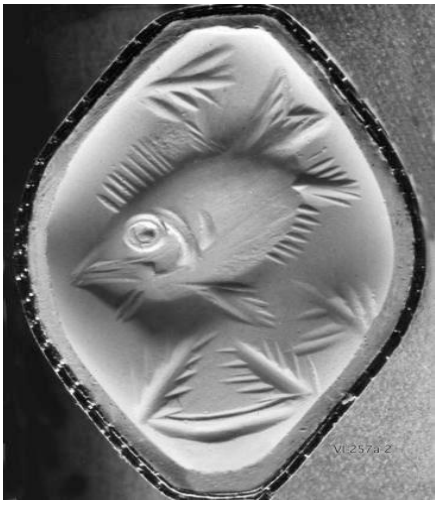


Fig. 1 **CMS VI No. 257** (Agate)

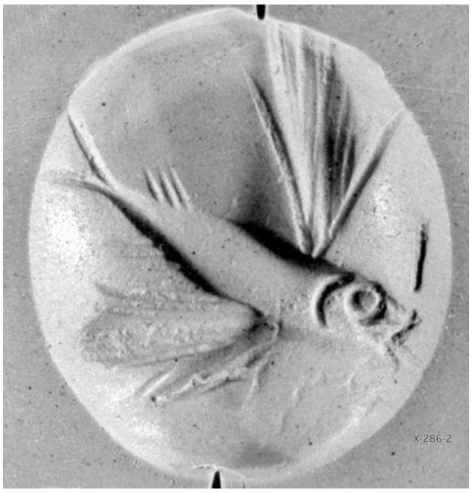
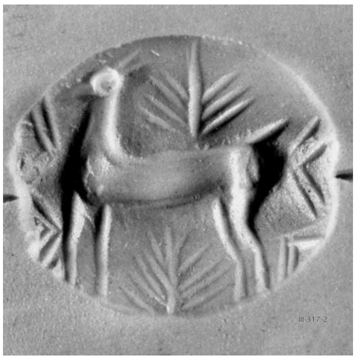
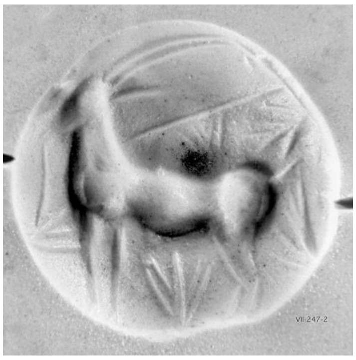


Fig. 2 CMS X No. 286 (Jasper)

Chapter 4, Plate 34

Naturalistic wild goats

		
Fig. 1 CMS II, 3 No. 153 (Amethyst)	Fig. 2 **CMS X No. 113b** (Carnelian)	Fig. 3 CMS III, 2 No. 317 (Carnelian)
		
Fig. 4 CMS XII No. 195 (Carnelian)	Fig. 5 CMS VII No. 247 (Carnelian)	Fig. 6 Sealing CMS II, 6 No. 59

Chapter 4, Plate 35

Other naturalistic motifs

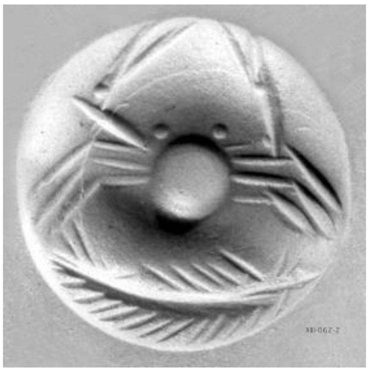
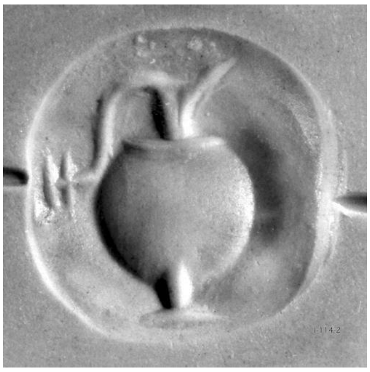


Fig. 1 CMS XIII No. 62 (Unclear stone)	Fig. 2 CMS VI No. 225 (Carnelian)	Fig. 3 **CMS III, 2 No. 507a** (Limestone)
		
Fig. 4 IV CMS No. 177 (Agate)	Fig. 5 CMS I No. 436a (Carnelian)	Fig. 6 CMS IV No. 42D (Carnelian)

Chapter 4, Plate 36

Motifs with realistic characteristics

		
Fig. 1 CMS VI No. 258b (Carnelian)	Fig. 2 CMS I No. 114 (Carnelian)	Fig. 3 **HM 2343 side a** (Carnelian)

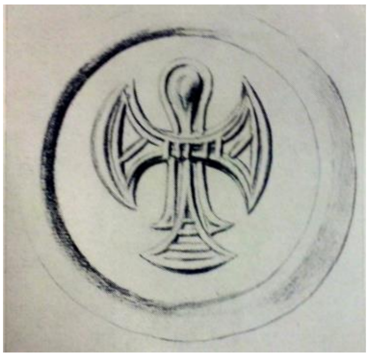



Fig. 4 **HM 2343 side b** (Carnelian)	Fig. 5 Sealing CMS II, 8 No. 54	

Chapter 4 - Plate 37

Eclectic motifs

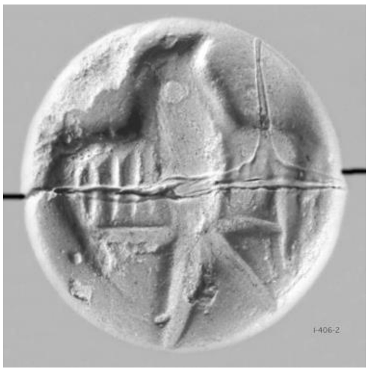
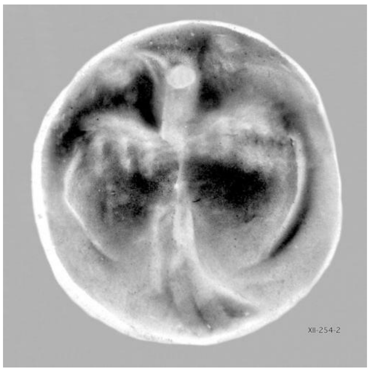
		

Fig. 1 CMS I No. 406 (Unclear stone)	Fig. 2 CMS VI No. 274 (Lapis lazuli)	Fig. 3 CMS XII No. 254 (Unclear stone)
		
Fig. 4 CMS II, 3 No. 356 (Unclear stone)	Fig. 5 CMS VII No. 144 (Schist)	Fig. 6 CMS III, 2 No. 507 (Limestone)

		
Fig. 7 Sealing CMS II, 6 No. 114	Fig. 8 Sealing CMS II, 6 No. 113	Fig. 9 CMS IS No. 169b (Amethyst)

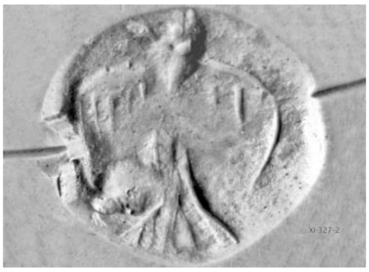



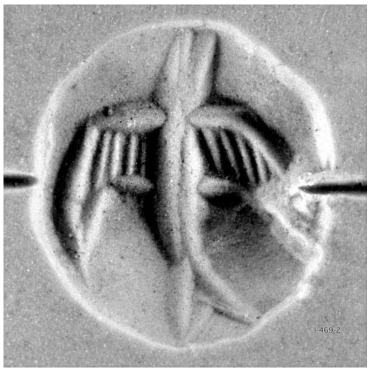
Fig. 10 CMS XI No. 327 (Slate)	Fig. 11 CMS XII No. 255 (Unclear stone)	Fig. 12 CMS II, 3 No. 148 (Serpentine)
		
Fig. 13 CMS VI No. 248 (Jasper)	Fig. 14 CMS XII No. 219 (Carnelian)	Fig. 15 CMS I No. 469 (Carnelian)

		
Fig. 16 stone CMS X No. 147 (Unclear stone)	Fig. 17 Sealing 17 CMS II, 6 No. 110	

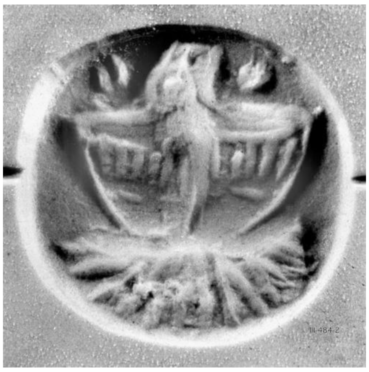



Fig. 18 CMS III, 2 No. 484 (Slate)	Fig. 19 CMS III, 2 No. 482 (Slate)	Fig. 20 CMS III, No. 483 (Slate)
		
Fig. 21 Sealing CMS II, 6 No. 111	Fig. 22 Sealing No. 112	

Chapter 4 - Plate 38

Eclectic wild goats

		
Fig. 1 CMS IX No. 103 (Agate)	Fig. 2 CMS XIII No. 144 (Carnelian)	Fig. 3 CMS VI No. 247 (Carnelian)

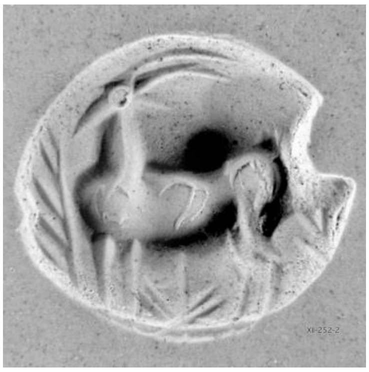



Fig. 4 CMS XII No. 252 (Carnelian)	Fig. 5 CMS II, 3 No. 259 (Pseudo-jasper)	


Fig. 6 CMS V No. 581 (Amethyst)

Chapter 4 - Plate 39

Eclectic composition

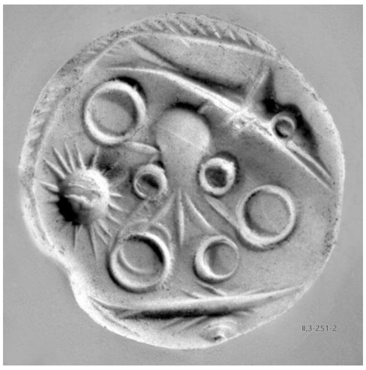
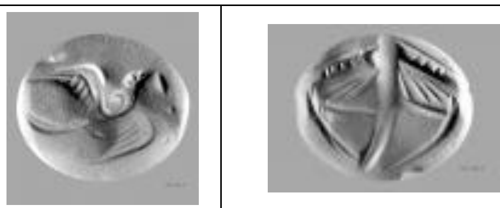
		
Fig. 1 CMS XIII No. 49 (Agate)	Fig. 2 CMS IX No. 162a (Agate)	Fig. 3 Carnelian CMS IV No. 244 (Carnelian)
		
Fig. 4 CMS X No. 248 (Carnelian)	Fig. 5 CMS X No. 117 (Jasper)	Fig. 6 CMS II, 3 No. 251 (Rock Crystal)
		
Fig. 7 CMS XII No. 188 (Rock Crystal)	Fig. 8 CMS II, 4 No. 13 (Unclear stone)	Fig. 9 CMS XII No. 210 (Unclear stone)

		
Fig. 10 CMS X No. 116 (Unclear stone)		

Chapter 4 - Plate 40

Three-sided prisms representing motifs with different styles

	
Fig. 1 CMS XII No. 162, sides a – b (Unclear stone)	Fig. 2 CMS XII No. 150 sides a, b and c (Ca No. 311)

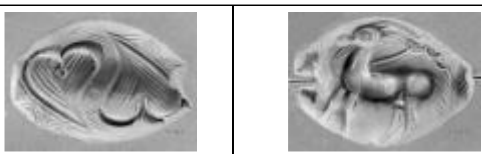



Fig. 3 CMS X No. 113, sides a – b (Ca No. 132)	Fig. 4 CMS III No. 507, sides a, b and c (Limestone)
	
Fig. 5 CMS I No. 436, sides a, b and c (Ca Nos. 106-327)	Fig. 6 CMS XI No. 20, sides a, b and c (Ca Nos. 97-342)

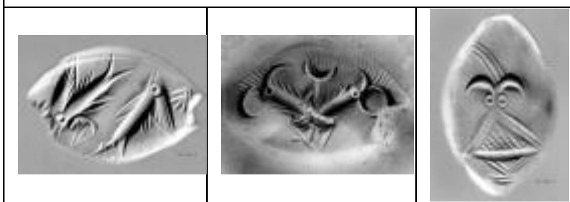
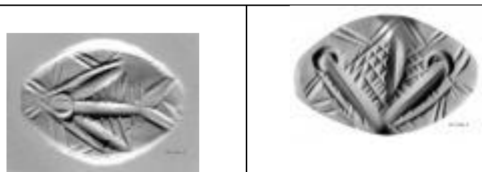
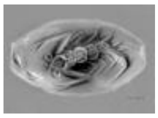
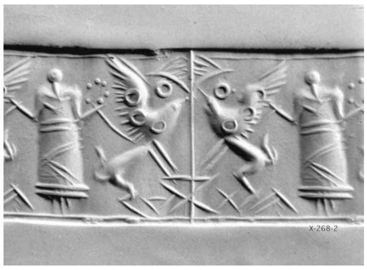

	

Fig. 7 CMS XII No. 185, sides a, b and c (Ca Nos. 345-268-319)	Fig. 8 CMS XII No. 186, sides a – b (Ca Nos. 122-323)

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Fig. 9 CMS II, 3 No. 12, sides a- b (Ca Nos. 142- 339)</td><td colspan="3">Fig. 10 CMS II, 3 No. 308, sides a, b and c (Ag Nos. 51- 96-102)</td></tr>
</table>

Chapter 4 - Plate 41

Non-talismanic motifs

		
Fig. 1 CMS XI No. 20a (Carnelian)	Fig. 2 CMS III, 2 No. 339 (Carnelian)	Fig. 3 CMS X No. 268 (Hematite)

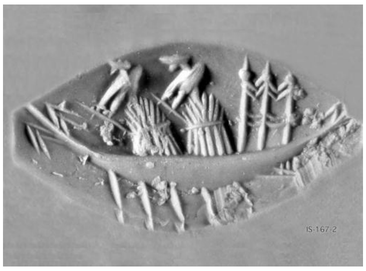
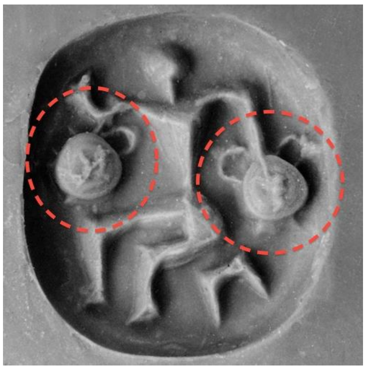
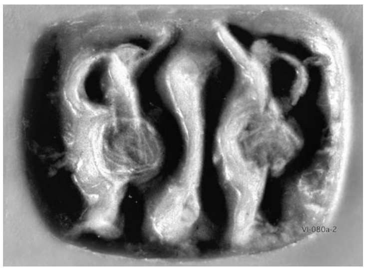



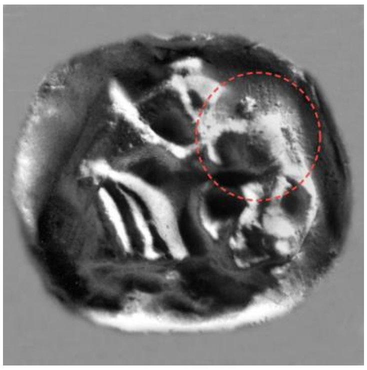
Fig. 4 CMS IS No. 167 (Unclear)		

Chapter 5 - Plate 1

The motifs of the amphora and the jug

		
Fig. 1 CMS XII No. 49a		Fig. 2 CMS III No. 251 (Ca No. 1)
		
Fig. 3 CMS VI No. 33a		Fig. 4 CMS VI No. 44a

		
Fig. 5 CMS IX No. 21b	Fig. 6 CMS XI No. 265a	Fig. 7 CMS VI No. 80a

		
Fig. 8 CMS III No. 347c (Ca No. 70)	Fig. 9 CMS II, 3 No. 359 (Ca No. 71)	Fig. 10 CMS XIII No. 80a

Chapter 5 - Plate 2

The motif of the ship

		
Fig. 1 CMS VI No. 74b	Fig. 2 CMS VIII No. 106 (Ca No. 90)	Fig. 3 CMS III No. 263 (Ca No. 88)

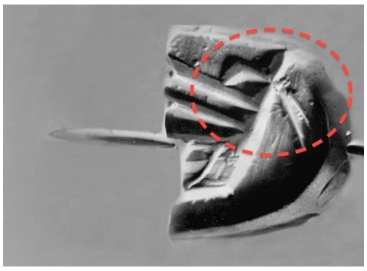
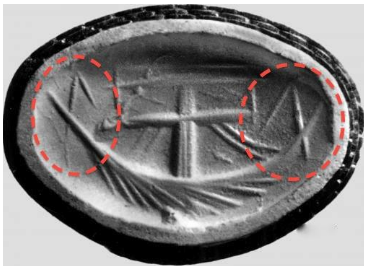
	

Fig. 4 CMS II, 2 No. 195	Fig. 5 CMS VI No. 256b (Ca No. 87)	Fig. 6 CMS VI No. 205 (Ag No. 28)

Chapter 5 - Plate 3

The motif of the lily/plant

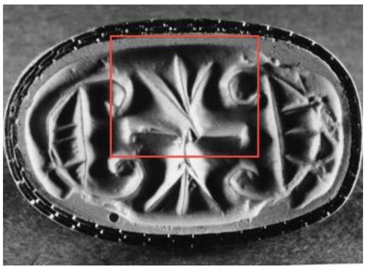
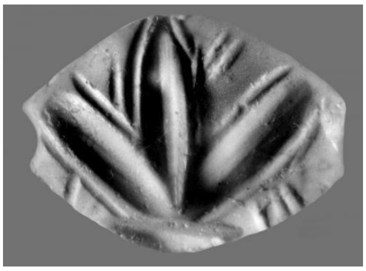
	

Fig. 1 CMS VI No. 74a	Fig. 2 CMS VI No. 189 (Ag No. 34)	Fig. 3 CMS XII No. 154 (Ca No. 113)

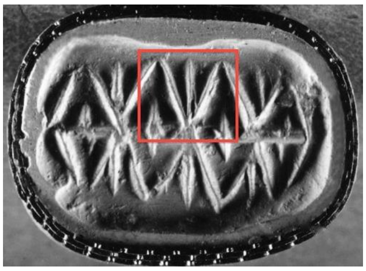
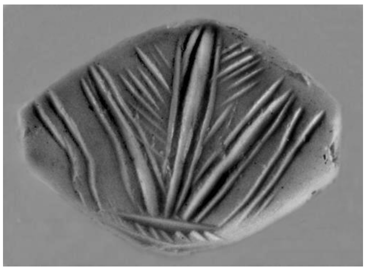
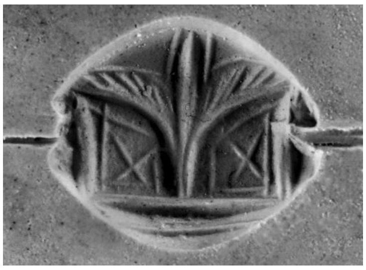
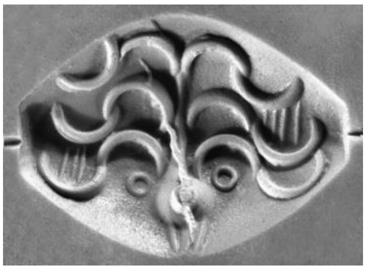

		

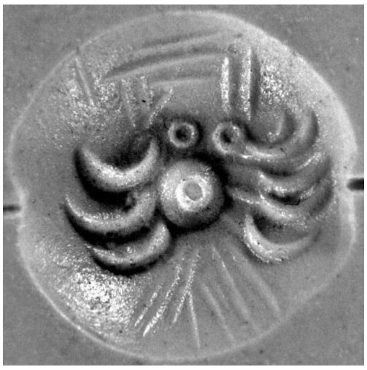
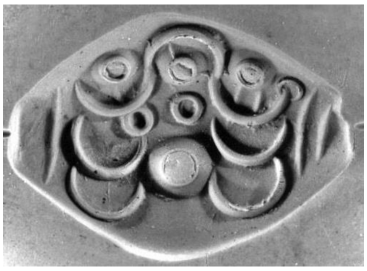
Fig. 4 CMS VI No. 89b		Fig. 5 CMS II, 3 No. 30 (Ca No. 114)
		
Fig. 6 CMS VII No. 29a		Fig. 7 CMS VII No. 226 (Ca No. 115)

Chapter 5 - Plate 4

The motif of the octopus

		
Fig. 1 CMS XII No. D9c	Fig. 2 CMS XI No. 158 (Ja No. 59)	Fig. 3 CMS II,3 No. 263 (Ja No. 58)

The motif of the crab

		
Fig. 4 CMS VII No. 30b	Fig. 5 CMS X No. 86 (Ca No. 178)	Fig. 6 CMS XI No. 90 (Ja No. 65)

Chapter 5 - Plate 5

The motif of the spider

		
Fig. 1 CMS IV No. 70a	Fig. 2 CMS III No. 185	Fig. 3 CMS XII No. 42b

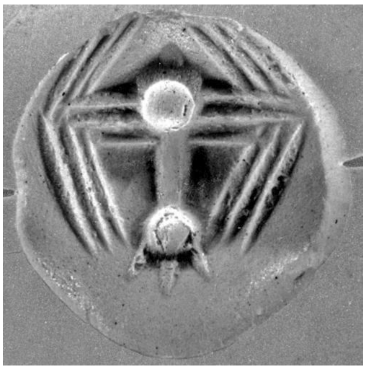
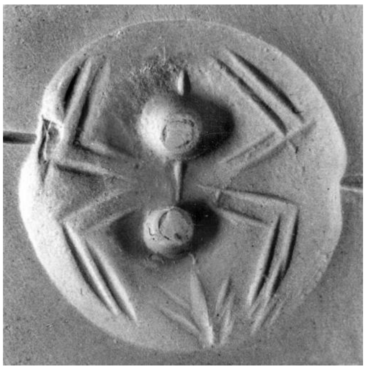
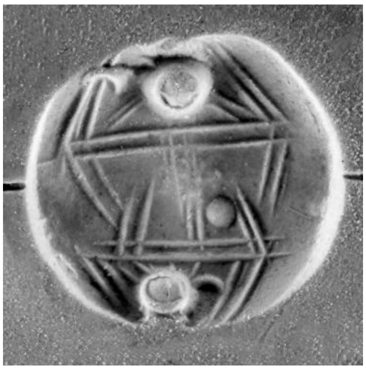

		

Fig. 4 CMS X No. 284 (Ca No. 180)	Fig. 5 CMS V No. 579 (Ca No. 186)	Fig. 6 CMS VII No. 234 (Ag No. 49)

Chapter 5 - Plate 6

The motif of the scorpion

		
Fig. 1 CMS III No. 200a	Fig. 2 CMS VI No. 63b	Fig. 3 CMS XII No. 15c
		
Fig. 4 CMS II 3 No. 308 (Ag No. 50)		Fig. 5 CMS XI No. 21 (Ca No. 188)

Chapter 5 - Plate 7

The motif of the double axe

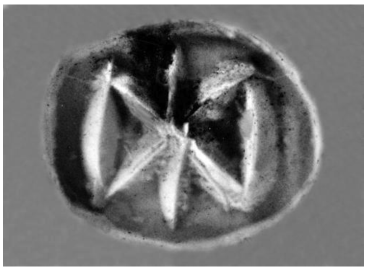
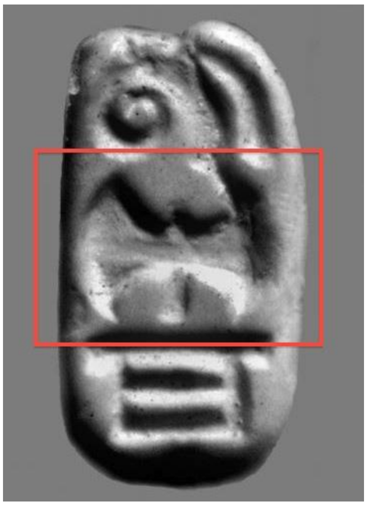
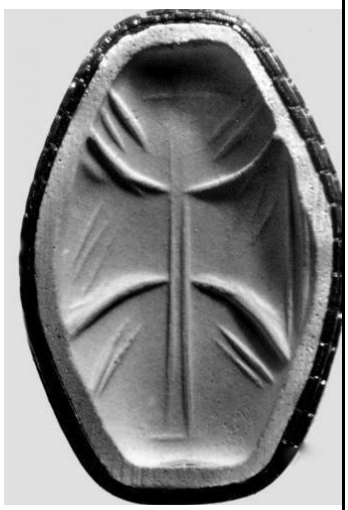
	

Fig. 1 CMS II, 2 No. 155c	Fig. 2 CMS IV No. 135a	Fig. 3 CMS VI No. 72a
		
Fig. 4 CMS IX No. 50 (Ca No. 252)	Fig. 5 CMS VI No. 240 (Ca No. 258)	Fig. 6 CMS VI No. 241 (Ja No. 114)

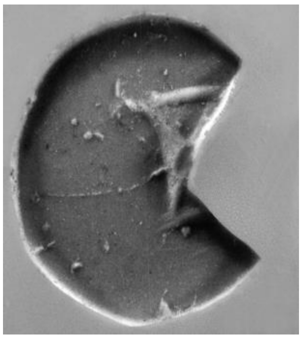


Fig. 7 CMS II, 2 No. 129		

Chapter 5 - Plate 8

The motif of the triangle

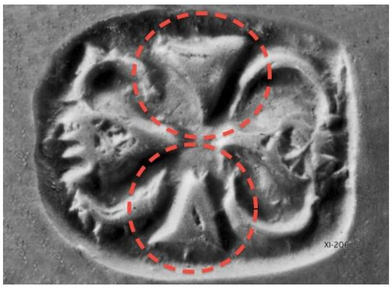
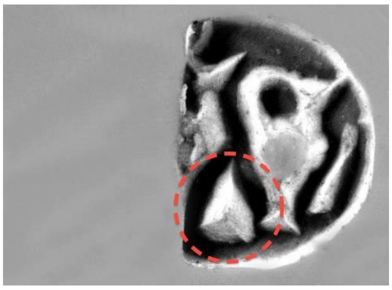
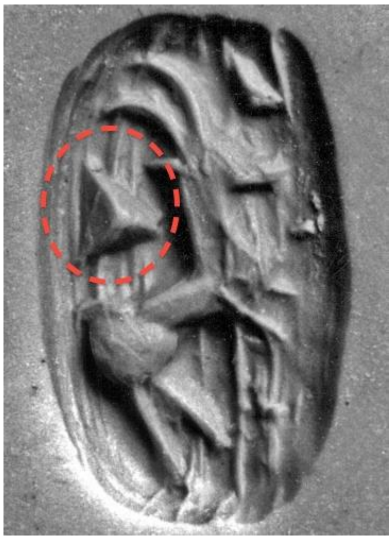
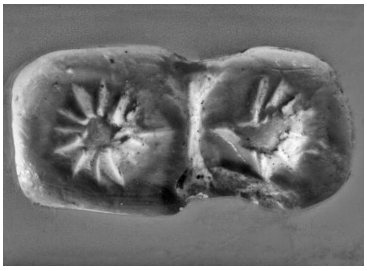
		

Fig. 1 CMS XI No. 206c	Fig. 2 CMS II, 2 No. 158b	Fig. 3 XI No. 265b
		
Fig. 4 CMS VI No. 244 (Ca No. 267)		Fig. 5 CMS XII No. 185c (Ca No. 268)

Chapter 5 - Plate 9

The motif of the rosette

		
Fig. 1 CMS II, 1 No. 276a	Fig. 2 CMS II, 2 No. 255b	Fig. 3 CMS VII No. 7a
		
Fig. 4 CMS III, 2 No. 314 (Ca No. 279)		Fig. 5 CMS III, 2 No. 315 (Ja No. 123)

Chapter 5 - Plate 10

The motif of the head of a ruminant/bucranium

		
Fig. 1 CMS VI No. 193 (Ca No. 286)		Fig. 2 CMS VI No. 43b
		
Fig. 3 CMS V No. 356c		Fig. 4 II, 3 No. 231a (Ca No. 290)

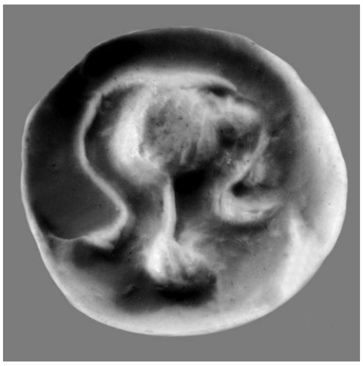
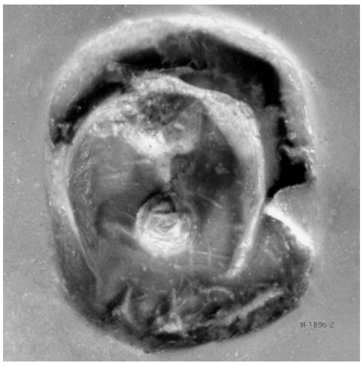
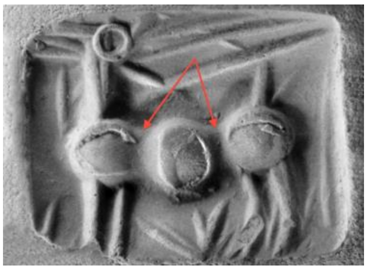
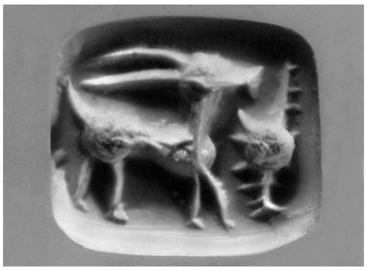

	

Fig. 5 CMS XII No. 12b	Fig. 6 CMS III No. 189b	Fig. 7 CMS X No. 76 (Ca No. 281)

Chapter 5 - Plate 11

The motif of the agrimi/wild goat

		
Fig. 1 CMS II, 2 No. 306a	Fig. 2 CMS VIII No. 2a	Fig. 3 CMS XI No. 217a
		
Fig. 4 CMS II, 3 No. 278 (Ca No. 145)	Fig. 5 CMS IX No. 102 (Ag No. 80)	Fig. 6 CMS VI No. 67c

		
Fig. 7 CMS VI No. 75c	Fig. 8 CMS II, 2 No. 224c	Fig. 9 CMS II, 2 No. 262a

Chapter 5 - Plate 12

The motif of the fish

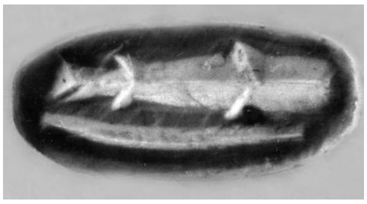
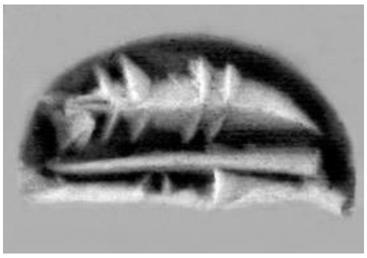
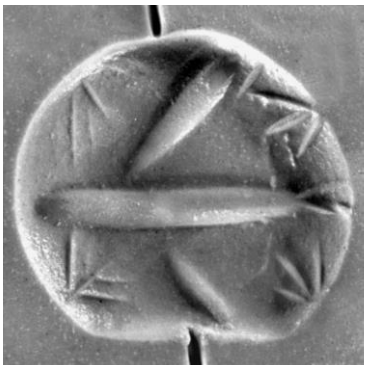
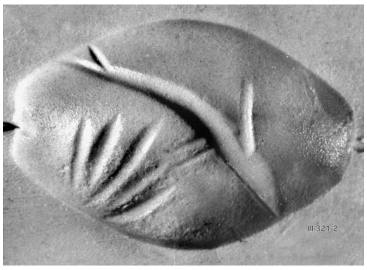
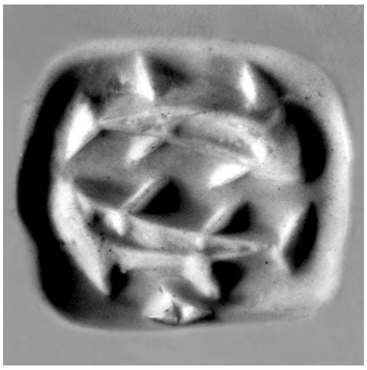
	

Fig. 1 CMS II, 2 No. 87b	Fig. 2 CMS II, 2 No. 122b	Fig. 3 CMS VII No. 216a
		
Fig. 4 CMS VI No. 46a	Fig. 5 CMS III No. 329 (Ja No. 135)	Fig. 6 CMS III No. 321 (Ca No. 208)
		
Fig. 7 CMS VI No. 82b	Fig. 8 CMS XII No. D2b	Fig. 9 CMS III No. 333 (Ja No. 137)

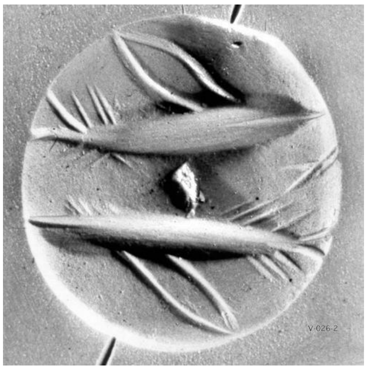
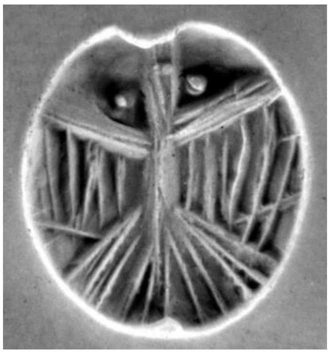


Fig. 10 CMS V No. 26 (Ja No. 133)	Fig. 11 CMS X No. 247 (Ca No. 313)	Fig. 12 CMS VIII No. 111b
		
Fig. 13 CMS VII No. 77 (Ca No. 316)		

Chapter 5 - Plate 13

The motif of the bird in frontal pose

		
Fig. 1 CMS III No. 159c	Fig. 2 CMS VI No. 78b	Fig. 3 CMS XIII No. 87c
		
Fig. 4 CMS II, 3 No. 53 (Ca No. 301)	Fig. 5 CMS X No. 98 (Ca No. 302)	Fig. 6 CMS XII No. 282 (Sch No. 1)

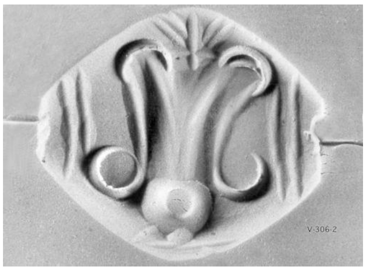
Chapter 6 - Plate 1

Amphora

Group 1		
		
Fig. 1 CMS VIII No. 44 (Ag No. 2) Provenance: absent		Fig. 2 Onassoglou p. 207 No. 33 Evans (1935, p. 446, Fig. 370c) Provenance: absent Ca No. 10

Group 2		
		
Fig. 1 CMS IV No. 45D (UnS No. 1) Sitia	Fig. 2 CMS IX No. 82 (Ag No. 4) Provenance: absent	Fig. 3 CMS III No. 245 (Ca No. 26) Agios Nikolaos, Mirabello

Group 2		
		
Fig. 4 CMS II, 3 No. 241 (Ca No. 16) Gournia, Necropolis of Sphoungaras		

Group 3		
		
Fig. 1 CMS VI No. 189 (Ca No. 13) Dikti Cave, Lasithi		Fig. 2 CMS V No. 306 (Ca No. 12) Pylos, Messinia, Palace of Nestor

Group 4		
		
Fig. 1 CMS VI No. 192 (Ca No. 7) Lato, Mirabello	Fig. 2 CMS IV No. 44D (Ag No. 6) Sykia, Sitia	Fig. 3 **CMS II, 3 No. 203b** (Ca No. 28) Geraki, Pediada

Group 5		
		
Fig. 1 CMS II, 3 No. 358 (Ca No. 29) Provenance: absent		Fig. 2 CMS III No. 249 (Ca No. 18) Mallia

Chapter 6 - Plate 2

Jug

Group 1		
		
Fig. 1 **CMS IX No. 89a** (Ag No. 14) Provenance: absent		Fig. 2 CMS IX No. 9D (Ag No. 15) Provenance: absent

Group 2		
		
Fig. 1 CMS VI No. 200 (Ca No. 59) Provenance: absent		Fig. 2 CMS VII No. 57 (Ca No. 66)

Group 3		
		
Fig. 1 CMS II, 3 No. 360 (Ca No. 73) Provenance: absent		Fig. 2 CMS VI No. 199 (Ca No. 58) Provenance: Sitia

Group 4		

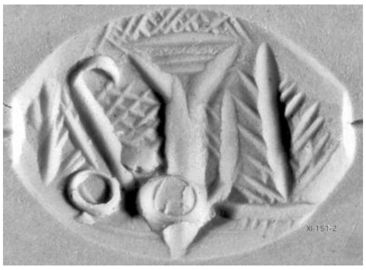
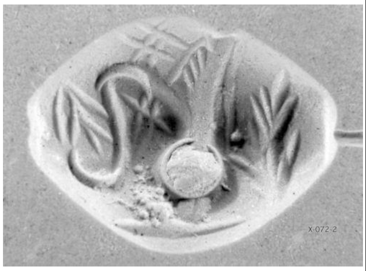



Fig. 1 CMS XI No. 151 (Ca No. 64) Provenance: absent	Fig. 2 CMS III No. 259 (Ca No. 57) Provenance: absent	Fig. 3 **CMS XII No. 187b** (Ca No. 60) Provenance: absent

Group 5		
		

Group 5		
Fig. 1 **CMS II, 3 No. 203a** (Ca No. 33) Provenance: Geraki, Pediada	Fig. 2 **CMS X No. 110a** (Ca No. 35) Provenance: absent	Fig. 3 CMS XII No. 155 (Cha No. 4) Provenance: absent

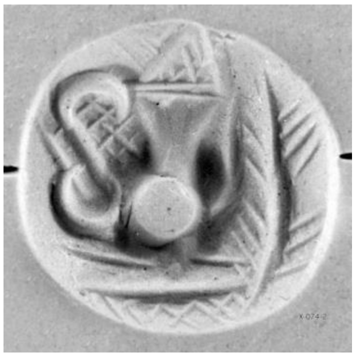
Group 6		
		
Fig. 1 CMS VII No. 47 (Ca No. 41) Provenance: absent	Fig. 2 CMS X No. 72 (Ca No. 38) Provenance: absent	Fig. 3 Lapis CMS VII No. 46 (LapLac No. 1) Provenance: Potami, Mirabello
		
Fig. 4 **CMS VI No. 193a** (Ca No. 39) Dikti Cave, Lasithi		

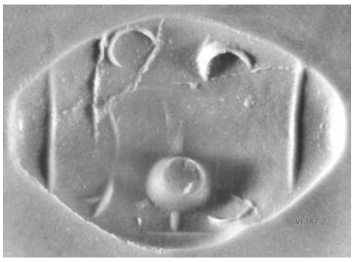
Group 7		
		
Fig. 1 CMS III No. 254 (Ser No. 1) Provenance: Absent		Fig. 2 CMS XIII No. 18D (UnS No. 7) Provenance: absent

Chapter 6 - Plate 3

Amphora + Jug

Group A	Amphora		Jug
			
	Fig. 1 Amphora CMS IX No. 8D (Ag No. 5) Provenance: absent		Fig. 2 Jug Group 3

Group B	Amphora		Jug
			
	Fig. 1 CMS VII No. 48 (Ca No. 9) Cyprus		Fig. 2 CMS X No. 74 (Ca No. 65) Provenance: absent

Group C	Amphora		Jug
			
	Fig. 1 CMS VI No. 187 (Ja No. 7) Provenance: Absent		Fig. 2 CMS II, 3 No. 130 (Ja No. 14) Katsambas

Group D	Amphora		Jug
D			
	Fig. 1 Amphora Group 4		Fig. 2 Jug CMS II, 3 No. 242 (Ca No. 67) Gournia, Sphoungaras (necropolis)

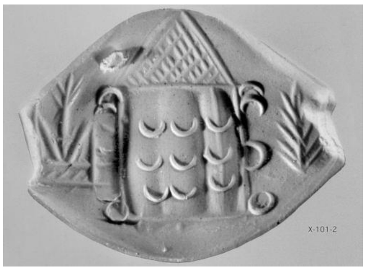
Group E	Amphora	Jug	Combination
			
	Fig. 1 Amphora Group 2	Fig. 2 Jug Group 2	Fig. 3 CMS IV No. 48D (AgCO No. 1) Tsoutsouros? Monofatsiu

Chapter 6 - Plate 4

Shrine

Group 1		
		
Fig. 1 CMS VI No. 201 (Ag No. 24) Provenance: East Crete		Fig. 4 CMS IX No. 86 (Ag No. 25) Provenance: absent

Group 2		
		
Fig. 1 CMS II, 3 No. 314 (Ja No. 15) Palekastro, Sitia		Fig. 2 CMS VI No. 204 (Ja No. 17) Provenance: absent

Group 3		
		
Fig. 1 CMS III No. 262 (Ca No. 80) Provenance: absent	Fig. 2 CMS X No. 228 (Ca No. 81) Provenance: Crete	Fig. 3 CMS X No. 101 (Ca No. 82) Provenance: absent

Chapter 6 - Plate 5

Ship's prow

Group 1		

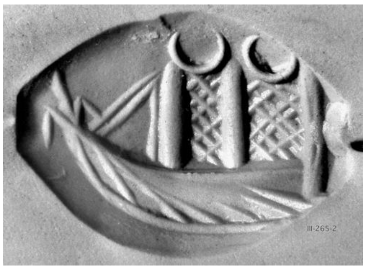



Fig. 1 CMS III, 2 No. 265 (Ca No. 91) Provenance: absent		Fig. 2 CMS VII No. 104 (Ca No. 92) Provenance: absent

Group 2		

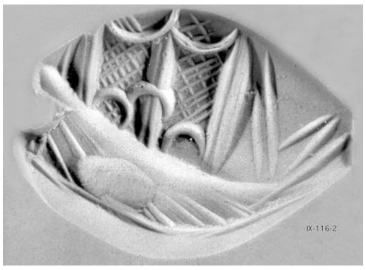
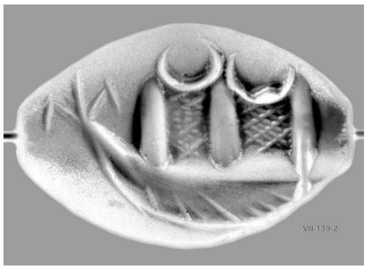

		

Fig. 1 CMS IX No. 116 (Ca No. 93) Provenance: absent	Fig. 2 CMS II, 3 No. 361 (Ca No. 107) Provenance: absent	Fig. 3 CMS VIII No. 139 (RoCry No. 1) Provenance: absent

Group 3		
		
Fig. 1 CMS X No. 276 (RoCry No. 3) Provenance: absent		Fig. 2 CMS VII No. 227 (Ca No. 86) Palekastro, Sitia

Group 4		

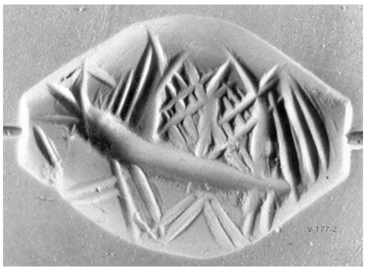
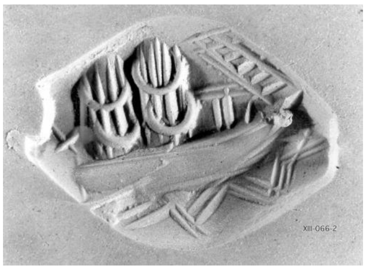
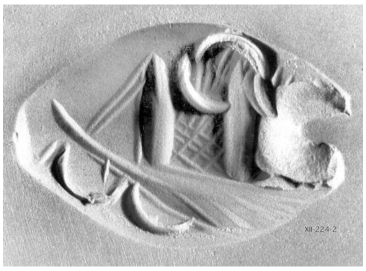



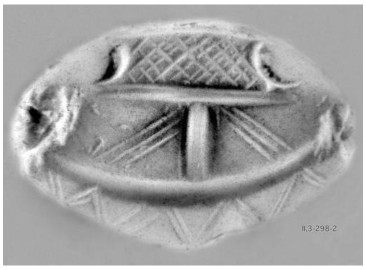
Fig. 1 CMS V No. 177 (Ca No. 94) Provenance: absent		Fig. 2 CMS VI No. 206 (Ja No. 19) Knossos

Group 5		
		
Fig. 1 CMS IX No. 117 (Ag No. 29) Provenance: absent		Fig. 2 CMS XIII No. 66 (Ag No. 30) Provenance: absent

Group 6		
		
Fig. 1 CMS II, 3 No. 207 (Ca No. 109) Karavado Pediada		Fig. 2 CMS XII No. 224 (Ca No. 98) Provenance: absent

Chapter 6 - Plate 6

Ship

Group 1		
		
Fig. 1 CMS X No. 100 (Ja No. 18) Provenance: absent	Fig. 2 CMS II, 3 No. 298 (Ca No. 89) Mirabello	Fig. 3 CMS III No. 263 (Ca No. 88) Lasithi
		
Fig. 4 **CMS VI No. 256b** (Ca No. 87) Lyttos, Pediada		

Group 2		
		
Fig. 1 CMS X No. 227 (Ca No. 103) Provenance: absent		Fig. 2 CMS VIII No. 106 (Ca No. 90) Provenance: absent

Chapter 6 - Plate 7

Octopus

Group 1		

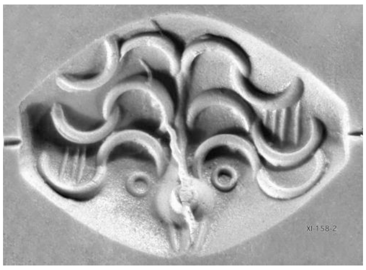
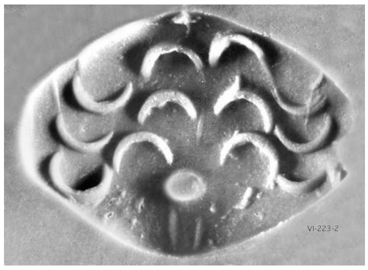

		

Fig. 1 CMS XI No. 158 (Ja No. 59) Provenance: absent		Fig. 2 CMS VI No. 223 (Ja No. 60) Provenance: absent
		
Fig. 4 CMS VII No. 80 (UnS No. 41) Provenance: absent		Fig. 3 CMS II, 3 No. 138 (Ja No. 61) Episkopi Pediada, grave Δ

Group 2		

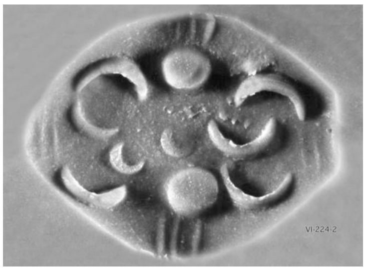



Fig. 1 CMS VI No. 224 (Ja No. 63) Provenance: absent		Fig. 2 CMS IV No. 188 (Ca No. 174) Provenance: Sitia

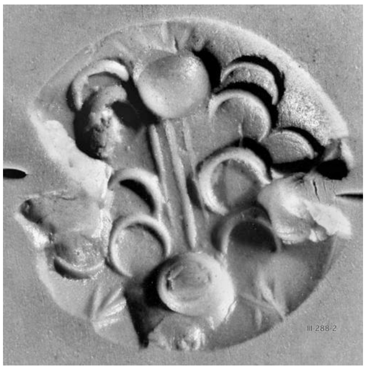
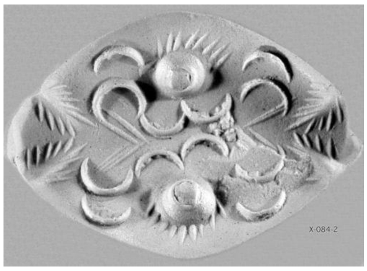

		

Fig. 3 CMS III No. 288 (Ca No. 175) Provenance: Mallia		Fig. 4 CMS X No. 84 (Ca No. 183) Provenance: absent

Group 3		

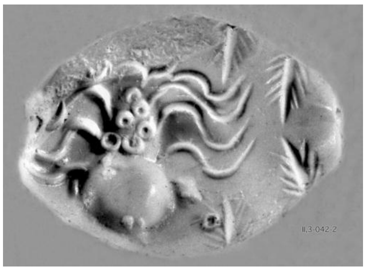
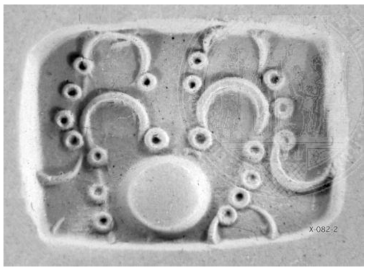

		

Fig. 1 CMS II, 3 No. 42 (Ca No. 171) Provenance: Knossos, grave 36		Fig. 2 CMS X No. 82 (Ag No. 47)

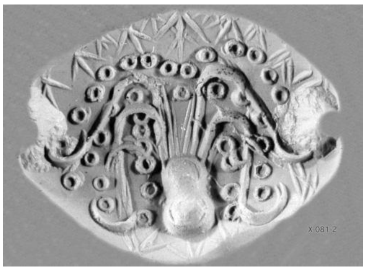
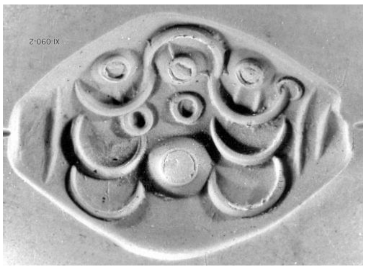



Fig. 3 CMS X No. 81 (Am No. 6) Provenance: absent		Fig. 4 CMS II, 3 No. 215b (Ca No. 172) Chersonissos, Pediada

Chapter 6 - Plate 8

Crab

Group 1		
		
Fig. 1 CMS XII No. 179 (UnS No. 43) Provenance: absent	Fig. 2 XI No. 90 (Ja No. 65) Provenance: absent	Fig. 3 CMS VII No. 78 (Ja No. 36) Provenance: Melos

Group 2		

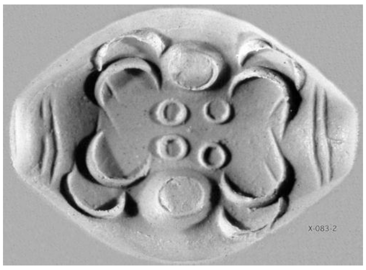
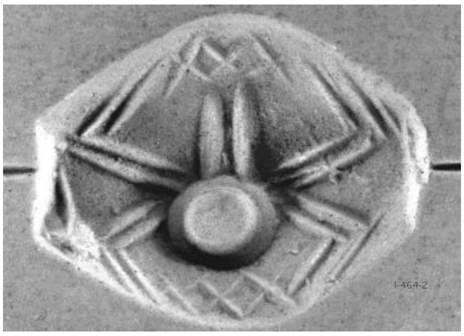



Fig. 1 CMS X No. 83 (Ja No. 66) Provenance: absent		Fig. 2 CMS IX No. 87 (Ja No. 67) Provenance: absent

Chapter 6 - Plate 9

Spider

Group 1		
		
1 CMS VI No. 226 (Ca No. 182) Provenance: absent		2 CMS I No. 464 (Ca No. 183) Provenance: absent

Group 2		

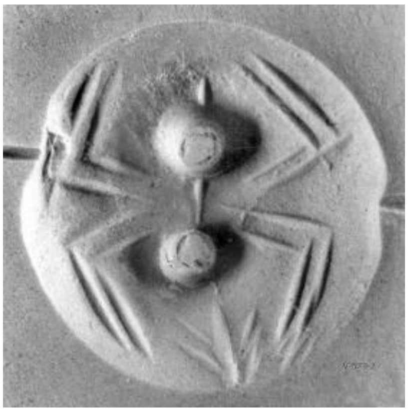
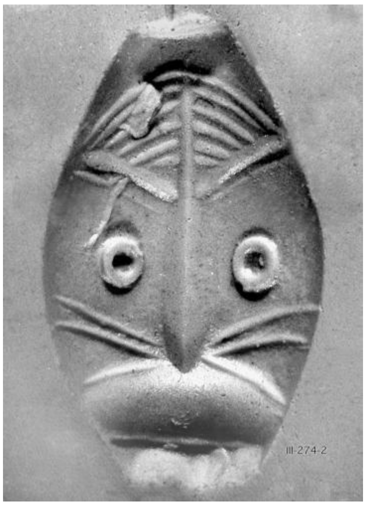



Fig. 1 CMS V No. 579 (Ca No. 186) Kasarma, Argolide		Fig. 2 CMS XII No. 148 (Ca No. 187) Provenance: absent

Chapter 6 - Plate 10

Papyrus

		
Fig. 1 **CMS II, 3 No. 12b** (Ca No. 142) Knossos	Fig. 2 CMS III, 2 No. 274 (Ca No. 140) Mallia	Fig. 3 CMS VI No. 211 (He No. 3) Knossos
		
Fig. 4 CMS II, 3 No. 253 (He No. 4) Mochlos, Sitia	Fig. 5 CMS VI No. 212 (Ca No. 141) Sitia	

Chapter 6 - Plate 11

Cuttlefish

Group 1		

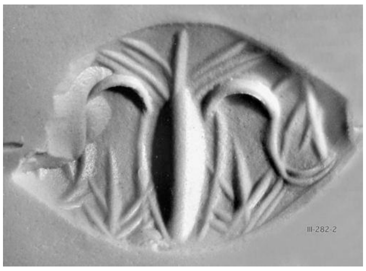



Fig. 1 CMS III, 2 No. 282 (Ca No. 149) Provenance: absent	Fig. 2 CMS II, 3 No. 2 (Ja No. 38) Rethymnon	Fig. 1 CMS VI No. 216 (Ca No. 147) Dikti Cave, Lasithi

Group 2		
		
Fig. 1 CMS XII No. 152 (Ja No. 40) Provenance: absent		Fig. 2 CMS IV No. 214 (Ja No. 41) Phaistos

Group 2		

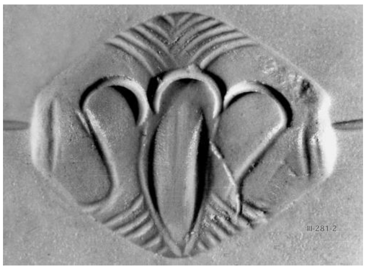
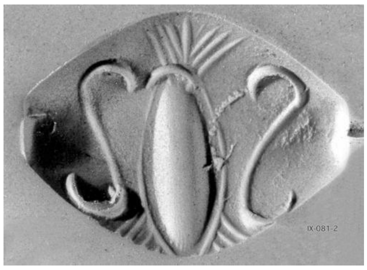

		

Fig. 3 III No. 281(Ja No. 44) Provenance: Phaistos		Fig. 4 CMS IX No. 81(Ag No. 40) Provenance: absent

Group 3		

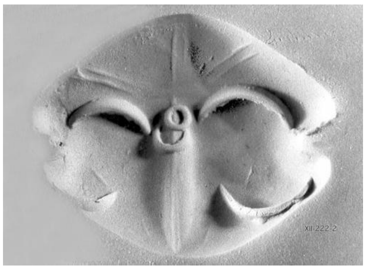
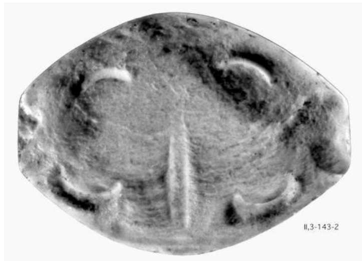
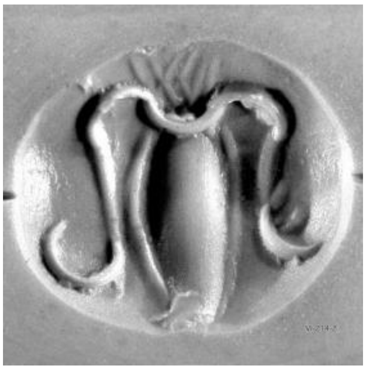

		

Fig. 1 CMS XII No. 222 (Ja No. 48) Provenance: absent	Fig. 2 CMS X No. 79 (Ja No. 49) Provenance: absent	Fig. 3 CMS II, 3 No. 143 (UnS No. 36) Vathypetron

Group 4		
		
Fig. 1 CMS XII No. 165 (Ja No. 55) Provenance: absent		Fig. 2 CMS III, 2 No. 277 (Ja No. 34) Provenance: absent

Group 5		
		
Fig. 1 CMS IV No. 47D (Ja No. 45) Loutraki, Malevisiou	Fig. 2 CMS II, 3 No. 362 (Ja No. 46) Provenance: absent	3Fig. CMS III, 2 No. 279 (Ca No. 167) Provenance: absent

Group 6		
		
Fig. 1 CMS IX No. 75 (Ja No. 42) Provenance: absent	Fig. 2 CMS VI No. 214 (UnS No. 39) Provenance: absent	Fig. 3 CMS VII No. 61 (UnS No. 32) Provenance: absent

Group 7		

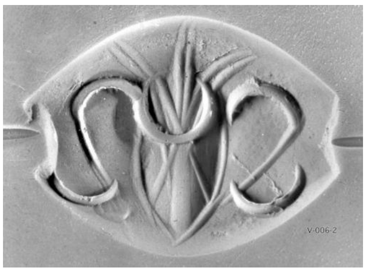
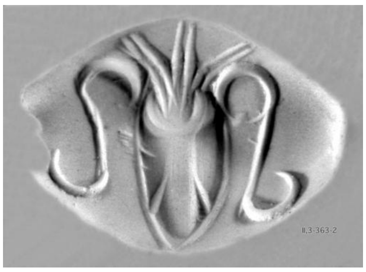
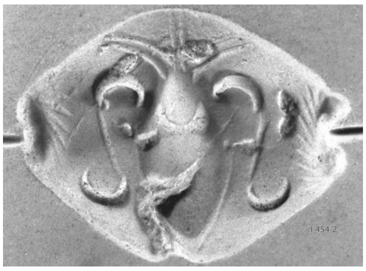
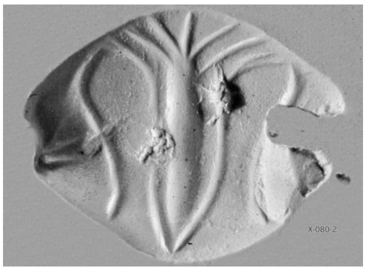

	

Fig. 1 CMS V No. 6 (RoCry No. 10) Egina, Temple of Athena Aphaia	Fig. 2 CMS II, 3 No. 363 (RoCry No.11) Provenance: absent	Fig. 3 CMS VI No. 219 (Ja No. 54) Provenance: absent

Group 7		
		
Fig. 4 CMS II, 3 No. 366 (Ja No. 47) Provenance: absent	Fig. 5 CMS II, 3 No. 365 (UnS No. 35) Provenance: absent	

Group 8		
		
Fig. 1 CMS X No. 78 (RoCry No. 9) Provenance: absent		Fig. 2 CMS VII No. 50 (Ca No. 170) Provenance: absent
		
Fig. 3 CMS VII No. 51 (Ca No. 154) Provenance: Sitia		Fig. 4 CMS I No. 454 (Ja No. 43) Provenance: absent

Group 9		
		
Fig. 1 CMS IV No. 196 (Ja No. 37) Sitia	Fig. 2 CMS III No. 278 (Ca No. 145) Knossos	Fig. 3 CMS X No. 80 (Ca No. 148) Provenance: absent

Group 10		

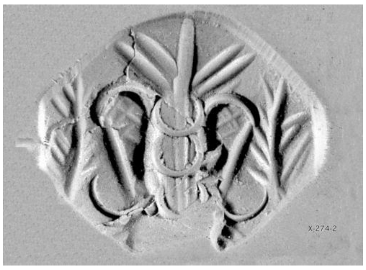
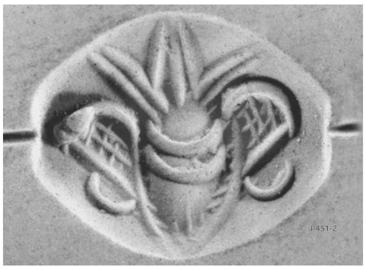

		

Fig. 1 CMS X No. 274 (Ca No. 162) Provenance: absent	Fig. 2 CMS IX No. 77 (Ag No. 45) Provenance: absent	Fig. 3 CMS I No. 451 (Ca No. 163) Provenance: absent

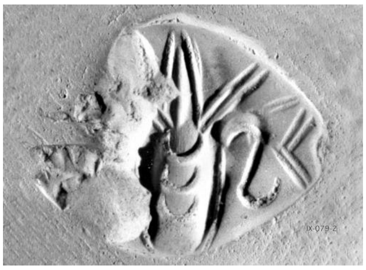
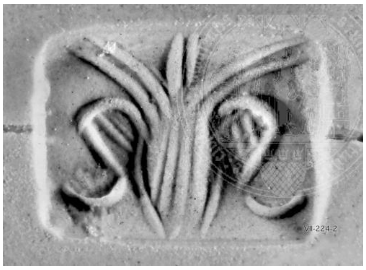



Fig. 4 CMS IX No. 79 (Ag No. 41) Provenance: absent		

Group 11		
		
Fig. 1 CMS II, 3 No. 29 (UnS No. 31) Knossos	Fig. 2 CMS VII No. 224 (Ca No. 151) West Crete	Fig. 3 CMS X No. 282 (Ca No. 164) Provenance: absent

Group 12		
		
Fig. 1 CMS II, 3 No. 35 (UnS No. 34) Knossos, Necropolis	Fig. 2 CMS III No. 286 (Sl No. 1) Provenance: absent	Fig. 3 CMS III No. 287 (Sl No. 2) Provenance: absent

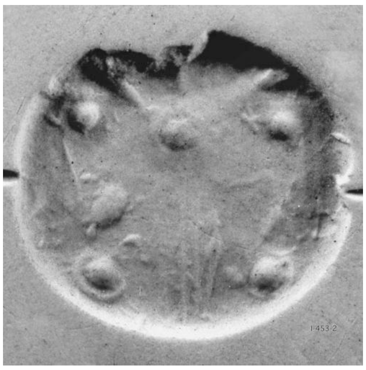
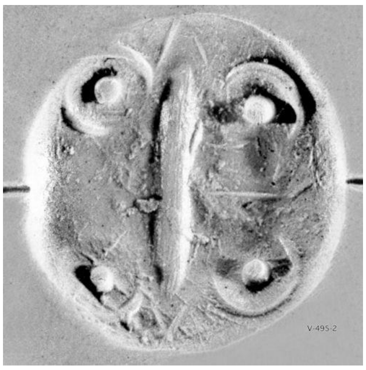
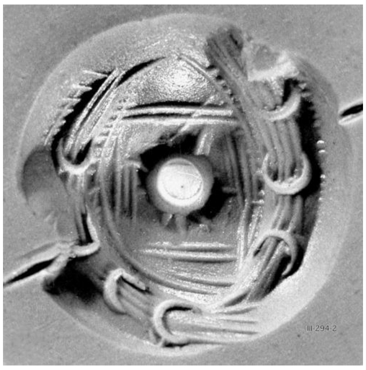

	

Fig. 4 CMS I No. 453 (PsJa No. 4) Provenance: absent	Fig. 5 CMS V No. 495 (UnS No. 91) Aghia Irini, Kea	

Chapter 6 - Plate 12

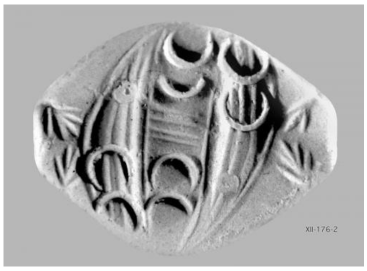
Forepart of fish

Group 1		
		
Fig. 1 **CMS XII No. 183c** (Ca No. 204) Provenance: absent		Fig. 2 CMS VII No. 222 (UnS No. 65) Provenance: absent

Group 2		
		
Fig. 1 **CMS XII No. 187a** (Ca No. 195) Provenance: absent		Fig. 2 CMS III, 2 No. 294 (Ca No. 207) Knossos
		

Group 2		
Fig. 3 CMS II, 3 No. 281 (Ca No. 194) Palekastro		Fig. 4 CMS VI No. 231 (Ja No. 69) Provenance: absent

Group 3		
		
Fig. 1 CMS VI No. 230 (Ag No. 53) Provenance: absent		Fig. 2 CMS V No. 430 (Ca No. 198) Karpophora, Messinia, tholos

Group 4		
		
Fig. 1 CMS II, 3 No. 295 (Ca No. 200) Elounda, Mirabello	Fig. 2 CMS VII No. 74 (Ag No. 51) Provenance: absent	Fig. 3 CMS XII No. 176 (Ag No. 54) Provenance: absent

Group 5		
		
Fig. 1 CMS XIII No. 110 (Ca No. 202) Provenance: absent	Fig. 2 CMS IX No. 70 (Ca No. 201) Provenance: absent	Fig. 3 CMS XI No. 93 (Ja No. 71) Provenance: absent

Chapter 6 - Plate 13

V-shaped panel

Group 1		

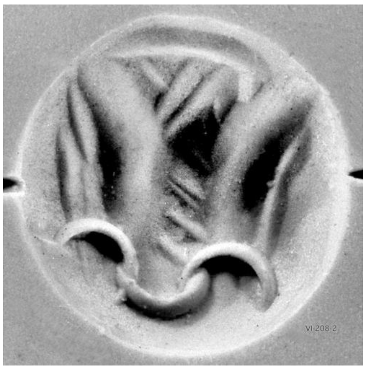



Fig. 1 CMS VI No. 208 (Ag No. 61) Provenance: absent		Fig. 2 CMS VI No. 234 (Ja No. 75) Provenance: absent

Group 2		
		
Fig. 1 CMS II, 3 No. 284 (Ca No. 229) Palekastro	Fig. 2 CMS III, 2 No. 297 (Ca No. 218) Provenance: absent	Fig. 3 CMS VI No. 233 (Ca No. 217) Provenance: absent

Group 3		
		
Fig. 1 CMS IV No. 218 (Ja No. 83) Roussochoria, Pediada	Fig. 2 CMS VIII No. 120 (Ja No. 84)	Fig. 3 CMS XI No. 157 (Ca No. 221) Provenance: absent
		
Fig. 4 CMS X No. 88 (Ja No. 86) Provenance: absent	Fig. 5 CMS III, 2 No. 298 (Ja No. 85) Provenance: absent	Fig. 6 CMS VII No. 84 (Ca No. 228) Provenance: absent

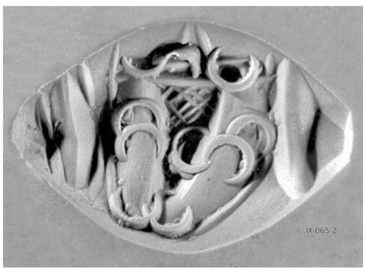



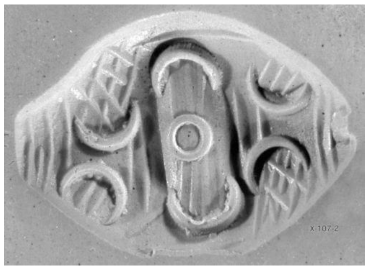
Fig. 7 CMS IX No. 65 (Ca No. 222) Provenance: absent		

Group 4		
		
Fig. 1 CMS XII No. 169 (Ca No. 223) Provenance: absent		Fig. 2 CMS X No. 214 (Ja No. 77) Provenance: absent

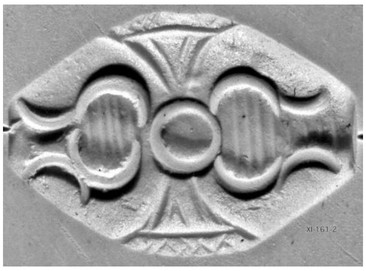
Group 5		
		
Fig. 1 **CMS II, 3 No. 231b** (Ca No. 208) Gournia, Palace	Fig. 2 CMS V No. 303 (Ca No. 213) Chora, Messenia	Fig. 3 CMS IX No. 63 (Ag No. 60) Provenance: absent

Chapter 6 - Plate 14

Panel

Group 1		
		
Fig. 1 CMS II, 3 No. 156 (Ca No. 234) Phaistos		Fig. 2 CMS X No. 107 (Ca No. 235) Provenance: absent

Group 2		
		
Fig. 1 CMS XIII No. 41 (UnS No. 49) Provenance: absent		Fig. 2 CMS XIII No. 64 (Ca No. 244) Provenance: absent

Group 3		
		

Group 3		
Fig. 1 CMS XI No. 161 (Ja No. 102) Provenance: absent	Fig. 2 CMS IV No. 241 (UnS No. 48) Rodopou, Kissamu	Fig. 3 CMS XII No. 192 (Ja No. 101) Provenance: absent

Group 4		
		
Fig. 1 CMS XII 167 (Ja No. 94) Provenance: absent	Fig. 2 CMS XIII No. 106 (Ja No. 95) Provenance: absent	Fig. 3 **CMS III No. 347a** (Ca No. 246) Provenance: absent

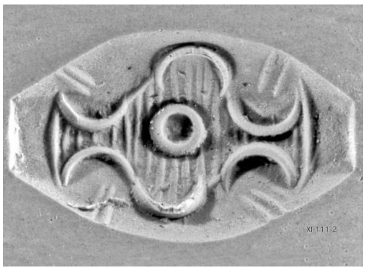
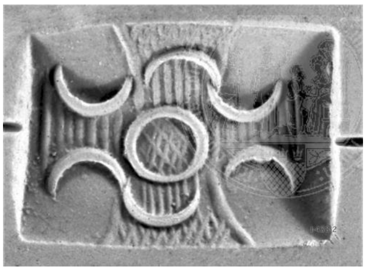

		

Fig. 4 CMS XI No. 111 (Ja No. 96) Phylakopi, Melos	Fig. 5 CMS XII No. 220 (UnS No. 54) Provenance: absent	Fig. 6 CMS I No. 438 (Ja No. 99) Provenance: absent

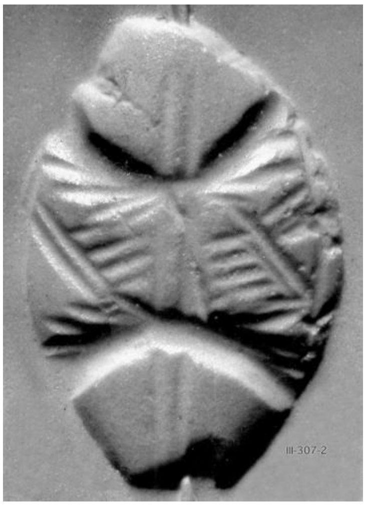
Group 5		
		

Group 5		
Fig. 1 CMS II, 3 No. 374 (Ja No. 97) Provenance: absent		Fig. 2 CMS IV No. 238 (Ja No. 98) Messara

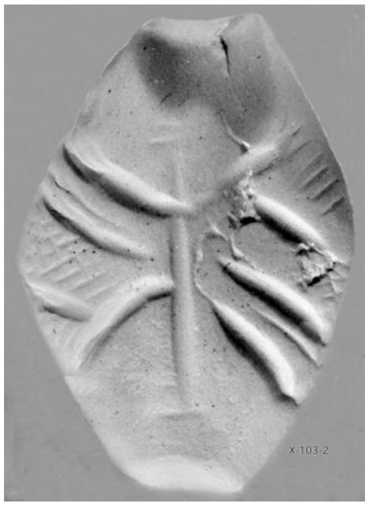
Chapter 6 - Plate 15

Double Axe

Group 1		
		
Fig. 1 CMS VI No. 243 (Ag No. 70) Provenance: absent	Fig. 2 CMS IX No. 49 (Ca No. 255) Provenance: absent	Fig. 3 CMS XII No. 153 (UnS No. 55) Provenance: absent

Group 2		
		
Fig. 1 CMS VI No. 242 (He No. 7) Dikti cave, Lasithi	Fig. 2 CMS III No. 307 (Ca No. 264) Provenance: absent	Fig. 3 CMS III No. 306 (Ca No. 265) Provenance: absent

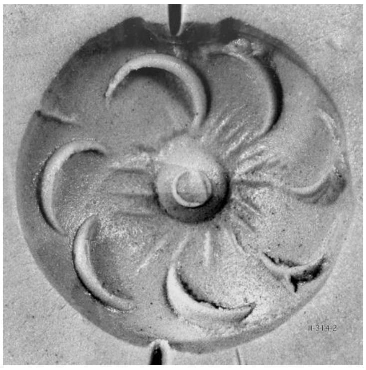
Group 3		
		
Fig. 1 CMS IX No. 47 (Ca No. 260) Provenance: absent		Fig. 2 CMS XIII No. 117 (Ca No. 259) Provenance: absent

Group 4		
		
Fig. 1 CMS II, 3 No. 235 (RoCry No. 21) Gournia, Ierapetra		Fig. 2 CMS X No. 103 (Ja No. 111) Provenance: absent

Group 5		
		
Fig. 1 CMS VII No. 55 (Ja No. 112) Provenance: absent		Fig. 2 CMS II, 3 No. 249 (RoCry No. 20) Gournia, Necropolis of Sphoungaras

Chapter 6 - Plate 16

Rosette

Group 1		
		
Fig. 1 CMS XII No. 157 (Ag No. 76) Provenance: absent		Fig. 2 CMS III No. 314 (Ca No. 279) Provenance: absent

Group 2		

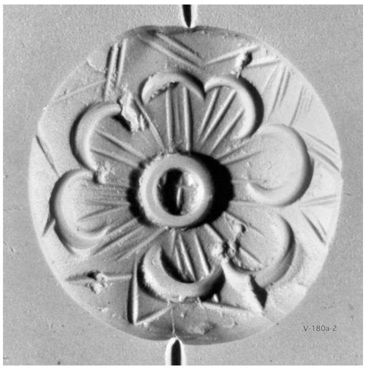
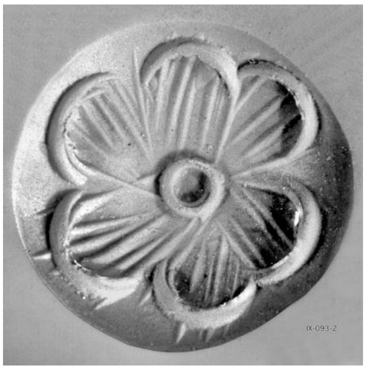

		

Fig. 1 CMS V No. 180 (Ca No. 277) Provenance: absent	Fig. 2 CMS IX No. 94 (Ag No. 75) Provenance: absent	Fig. 3 CMS IX No. 93 (Ag No. 77) Provenance: absent

Chapter 6 - Plate 17

Bucranium

Group 1		

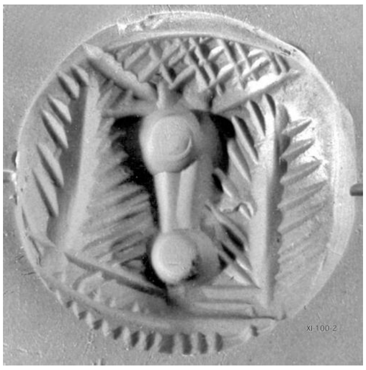



Fig. 1 CMS XI No. 100 (Ca No. 288) Provenance: absent		Fig. 2 **CMS IX No. 89b** (Ag No. 79) Provenance: absent

Group 2		

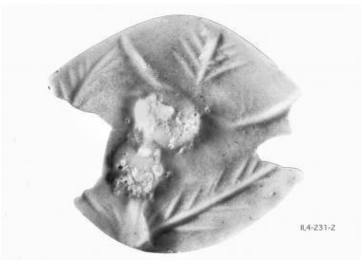



Fig. 1 CMS II, 4 No. 231 (Ca No. 285) Provenance: absent	Fig. 2 CMS II, 3 No 289 (Sl No. 3) Psychro	Fig. 3 CMS IV No. 236 (Ja No. 125) Aimonas

Chapter 6 - Plate 18

Triangles

Group 1		
		
Fig. 1 CMS II, 3 No. 139 (Ja No. 116) Episkopi Pediada (Kephala, grave Δ)		Fig. 2 CMS IV No. 251 (Ja No. 117) Aphrati

Group 2		

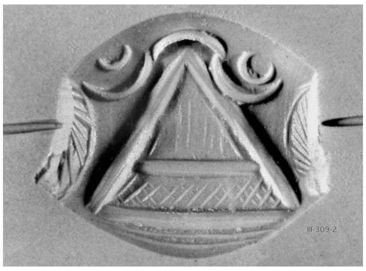
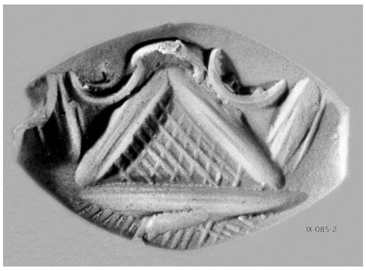

		

Fig. 1 CMS III No. 309 (Ca No. 270) Knossos		Fig. 2 CMS IX No. 85 (RoCry No. 22) Provenance: absent

Group 3		

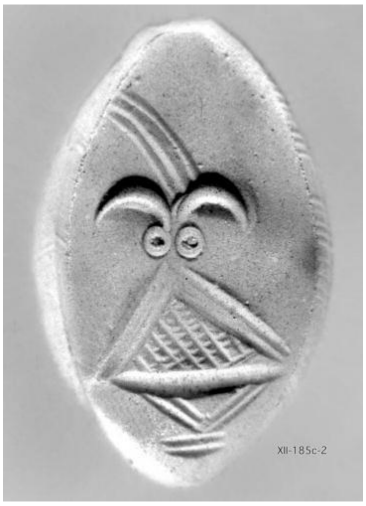



Fig. 1 **CMS XII No. 185c** (Ca No. 268) Provenance: absent		Fig. 2 CMS XII No. 202 (Ca No. 269) Provenance: absent

Chapter 6 - Plate 19

Wavy lines

Group 1		
		
Fig. 1 CMS VIII No. 54 (Ja No. 118) Provenance: absent		Fig. 2 CMS V No. 648 (UnS No. 56) Provenance: absent

Group 2		

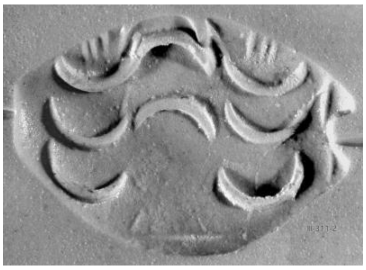



Fig. 1 CMS III No. 311 (Lim No. 1) Lasithi	Fig. 2 CMS III No. 310 (Ja No. 119) Provenance: absent	Fig. 3 CMS II, 3 No. 300 (Ja No. 121) Mirabello

Chapter 6 - Plate 20

Fish

Group 1		

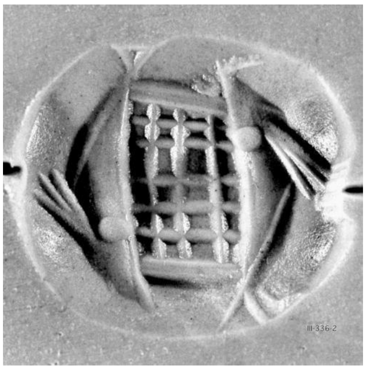
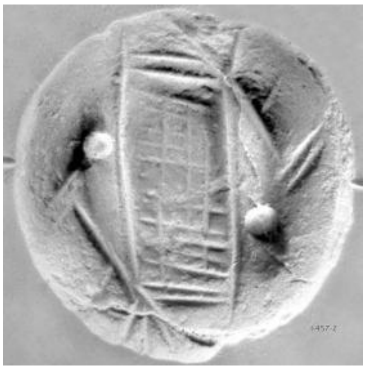

		

Fig. 1 CMS III No. 336 (Ca No. 334) Provenance: Mallia		Fig. 2 CMS I No. 457 (PsJa No. 6) Provenance: absent

Group 2		
		
Fig. 1 CMS II, 4 No. 95 (Ser No. 12) Provenance: absent		Fig. 2 CMS XII No. 256 (UnS No. 78) Provenance: absent

Group 3		

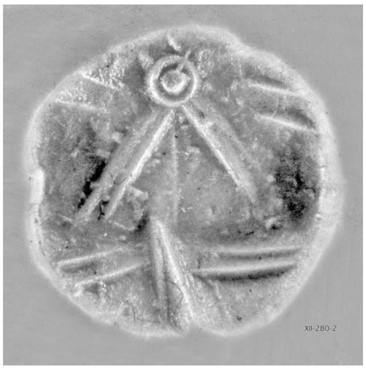
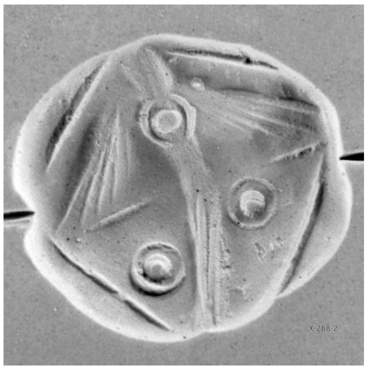



Fig. 1 CMS XII No. 280 (UnS No. 79) Provenance: absent		Fig. 2 CMS IV No. 205 (UnS No. 75) Provenance: Aimonas, Milopotamou

Group 4		
		
Fig. 1 **CMS XII No. 150b** (Ca No. 311) Provenance: absent	Fig. 2 CMS II, 3 No. 262 (Ser No. 11) Mochlos, Sitia	Fig. 3 CMS X No. 288 (UnS No. 80) Provenance: absent

Group 5		
		
Fig. 1 CMS X No. 247 (Ca No. 313) Provenance: absent		Fig. 2 CMS VII No. 77 (Ca No. 316) Provenance: absent

Group 6		

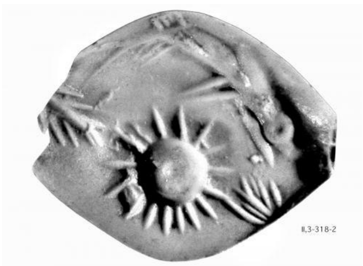
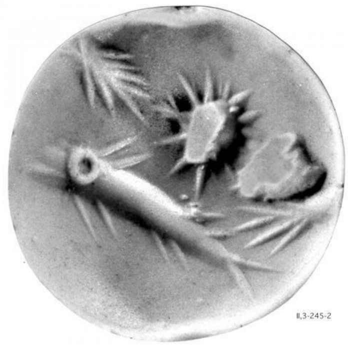

		

Fig. 1 CMS II, 3 No. 318 (Ca No. 340) Palekastro, Sitia		Fig. 2 CMS II, 3 No. 245 (Am No. 9) Gournia, Ierapetra, Necropolis of Sphoungaras

Group 7		

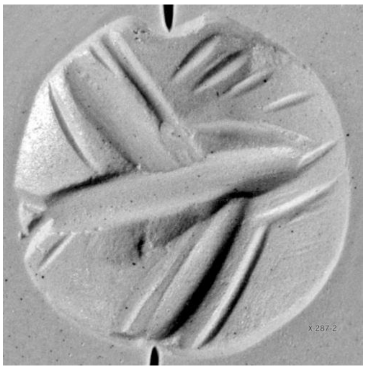
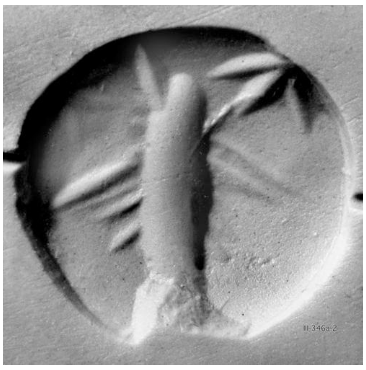
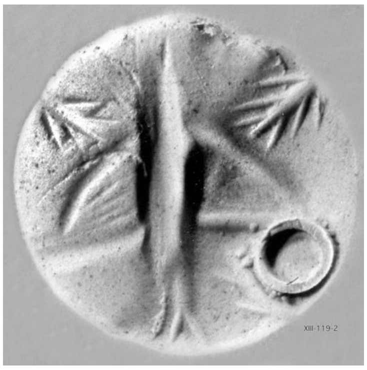
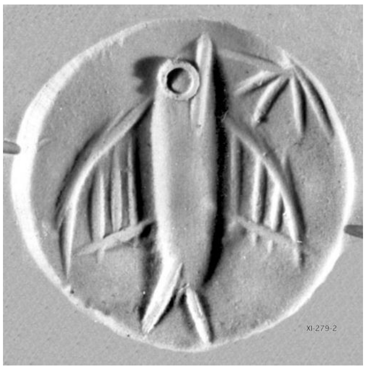



Fig. 1 CMS X No. 287 (Ag No. 81) Provenance: absent		Fig. 2 CMS IX No. 59 (Ag No. 91) Provenance: absent

Group 8		
		
Fig. 1 CMS IV No. 186 (RoCry No. 28) Messara		Fig. 2 **CMS III No. 346a (**Ag No. 94) Provenance: absent

Group 9		
		
Fig. 1 CMS IX No. 57 (Ag No. 92) Kritsa	Fig. 2 CMS XIII No. 119 (Ca No. 305) Provenance: absent	Fig. 3 CMS XI No. 279 (UnS No. 87) Provenance: absent

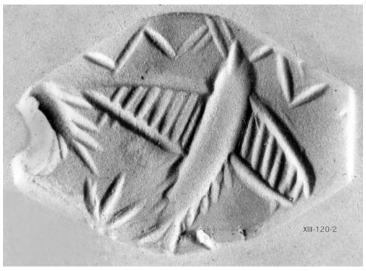



Fig. 4 CMS XIII No. 120 (Cha No. 12) Provenance: absent		

Group 10		

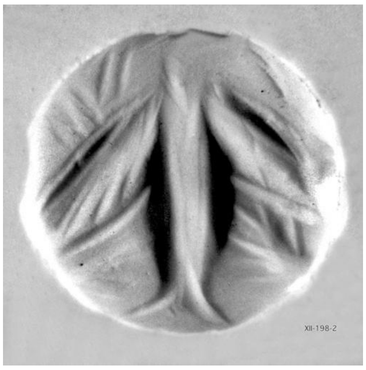
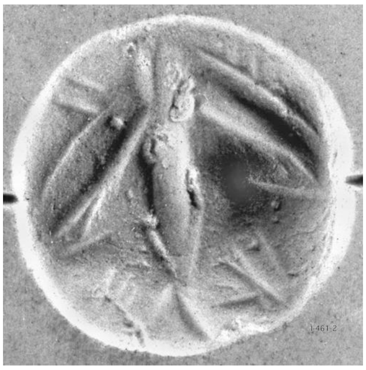

	

Fig. 1 CMS XII No. 198 (RoCry No. 26)	Fig. 2 CMS I No. 461 (UnS No. 81) Provenance: absent	Fig. 3 CMS II, 3 No. 246 (UnS No. 85) Gournia, Sphoungaras

Chapter 6 - Plate 21

Isolated motifs

Group 1		

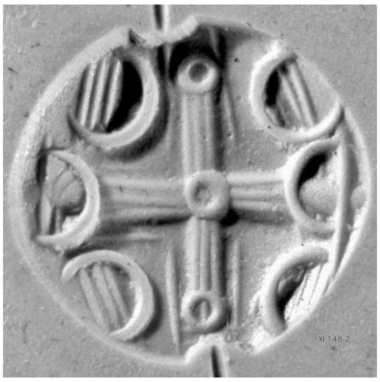
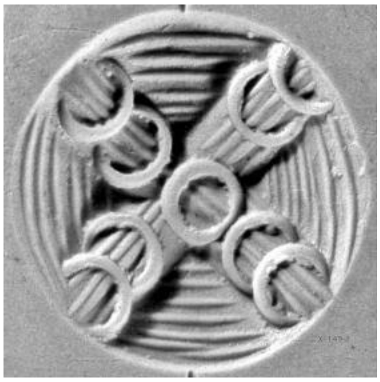

		

Fig. 1 CMS XI No. 148 (Ag No. 103) Athens		Fig. 2 CMS XI No. 149 (Ag No. 104) Provenance: absent

Group 2		

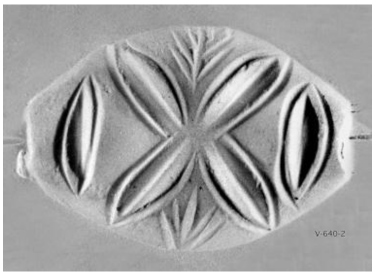



Fig. 1 CMS V No. 640 (Ca No. 359) Kokounara, Ilia	Fig. 2 CMS III No. 346b (Ag No. 94)	Fig. 3 CMS II, 3 No. 268 (UnS No. 73) Provenance: Mochlos Sitia

Chapter 4 - Appendix 1

The composition of the talismanic motifs

Description of the analysis

Compositional analysis was carried out on a series of seals in collections at the National Archaeological Museum of Athens, the Metropolitan Museum of Art of New York, and at the British School of Athens. This analysis involved the use of a digital microscope to magnify the seal-surfaces[1] to distinguish each tool mark and to reconstruct the sequence of the cuts which compose the talismanic figures.

A total of 15 talismanic motifs have been analysed: amphora, jug, ship's prow, plant, cuttlefish, crab, spider, scorpion, forepart of fish, panel v-shaped, panel, double axe, rosette, triangle and fish.

Analysis

Amphora (Pl. 7). In CMS XII No. 143, it is clear that the main tools involved were the cutting wheel and the tubular drill. At first glance, it seems that the first cut was the circle at the centre of the seal-surface, but looking carefully the first cut was the straight line made by a broad cutting wheel (Fig. 1); the circle overlaps it and was made by a tubular drill (Fig. 2).

Then, two lines were engraved to make the neck and a third line was added to make the rim of the amphora (Fig. 3). The engraver created the handles. At the top of the right side of the amphora's body, the first semicircle was overlapped on the rim of the amphora (Fig. 4). The handles were made by the S-shaped cut, which is a peculiar cut and common in this style. This S-shaped cut was made by two semicircles plus an interconnective line between them, made by a simple tubular drill and cutting wheel respectively. The semicircle which overlaps the rim was engraved first, followed by a line which connects the other semicircle (Fig. 5). The same cut can be seen on the left side (Fig. 6), but the

[1] The magnification used for this analysis was between 50x and 200x.

interconnection between the semicircles is not very precise. To complete the amphora, a lid was engraved and it is composed of four lines, the two on the left were cut first and then the other two (Fig. 7). Finally, the composition was completed with ornamental motifs, which in this case are two groups of plants made by the wheel in the upper field, with a total of six cuts for the plant on the left side of the seal-surface and five for the other (Figs. 8-9). The entire composition uses 26 cuts (Figs. 10-11) while the talismanic amphora was created with 15 cuts.

Jug (Pl. 8). The jug represented in CMS V No. 207 was created by a simple tubular drill and a cutting wheel. Also, in this case the artisan started engraving a circle to make the belly of the jug using a simple tubular drill (Fig. 1). The next step was creating the neck. A double cut can be noted on the left line which makes the neck (Fig. 2) and this indicates that the engraver did not make a straight line. For the neck, three cuts were engraved while only two cuts were made by the cutting wheel (Figs. 3-4) to complete the upper part of the figure. The foot of the amphora was also made with the wheel and it consists of four cuts (Fig. 5). The handle is represented with the S-shaped cut (Fig. 6). The basic jug was made with a total of 14 cuts.

After the jug was made, ornamental motifs were added. Although the stone is fractured it is possible to see how the engraver created them. A couple of plants are located on the left side of the stone (Figs. 7-8). They were engraved by a cutting wheel using a total of 12 cuts. Finally, cross-hatching can be seen on the opposite side and it was disposed inside the handle using six cuts (Fig. 9); three other lines are on the right side of the handle. These last ornamental motifs were created with nine strokes of the wheel, and the entire composition was created with a total of 35 cuts (Figs. 10-11).

Ship's prow (Pl. 9). In CMS XII No. 224, the motif has been worked with different typologies of cutting wheel and with the simple tubular drill. The creation of this motif is peculiar and it is very well worked. The typical prow shape was made by the broad wheel used perpendicularly and obliquely in one cut (Fig. 1) and then two lines were added as contours (Fig. 2) with four overlapped on it (Fig. 3). One line was added and elongated to shape the prow (Fig. 4).

The two masts would seem to have been added onto the prow and they were again created with the broad cutting wheel pressed deeply on the seal-surface. They were shaped as two ellipsoidal lines and on these two cuts, two lines have been engraved (Fig 5). On the mast on the right side of the seal-surface, a vertical line was engraved, and next to this line two other oblique lines were engraved after it (Fig. 6), for a total of 14 cuts for the ship's prow.

Moreover, in this motif a series of ornamental motifs appear. Between the masts the cross-hatching was made by 13 strokes of the cutting wheel (Fig. 7), followed by a semicircle overlapping it. There are semicircles disposed on the left side of the figure: one was engraved clearly after the cross-hatching (Fig. 8); the others are located at the top of the left mast (Fig. 9). It would seem that the circle at the top was engraved first but it is not certain, and an imprecision in using the tubular drill can be noted (Fig. 10). The imprecision may confirm that the semicircle at the top was engraved first because the engraver was trying to connect the two semicircles but missed on the first attempt so he added another stroke to correct the orientation of the semicircle. Two other semicircles can be noted under the prow and they were also engraved after it (Fig. 11). The prow of the ship was made with 17 cuts while the ornamental motifs were made with 18 cuts, for a total of 35 cuts (Figs. 12-13).

Plant (Pl. 10). CMS XII No. 154 shows a plant made using only the wheel. The first cut was the elongated oval disposed on the centre of the seal-surface (Fig. 1). Subsequently, five lines were engraved on both sides of this cut, which are visible on the cast (Fig. 2). The next step was to create a V-shaped cut (Fig. 3), followed by two parallel lines engraved under it (Fig. 4). On the bottom left, five lines have been engraved (Fig. 5) and the sequence of the cuts can be seen. Then, on the bottom right two other lines were engraved to complete the icon, and one of them overlaps one of the parallel lines (Fig. 6). A total of 22 cuts compose this motif (Figs. 7-8).

Cuttlefish (Pl. 11). In CMS XII No. 152, the cutting wheel is the main tool involved in creating this icon. The artisan started making the body of the cuttlefish which is represented by a stroke made by a broad-edged wheel (Fig. 1).[2] The body of the cuttlefish has been incorporated into two slightly curved lines disposed on both sides and made by a thin wheel (Fig. 2).

At the top of the body, a semicircle was added with a simple tubular drill (Fig. 3). It would seem that the tentacles, created by 10 lines using the wheel, were engraved before the fins as the semicircle that overlaps the line on the left suggests (Figs. 4-5-6). Finally, to complete this motif, the fins were added with the group of S-shaped cuts (Figs. 7-8). A total of 19 cuts created this composition (Figs. 9-10).

Crab (Pl. 12). In CMS XII No. 179, the artisan started from the central body which is made by a circle created using two different drills (Fig. 1). A first cut was made by a solid drill and then a tubular drill overlaps the previous cut (Fig. 2). The legs were made of four semicircles using a tubular drill (Fig. 3), and then at the top of the body two little circles were made by the tubular drill (Fig. 4). On the right side of the seal, there are three lines made by the cutting wheel, which were probably engraved before the upper semicircle (Fig. 5) and, strangely, they cannot be seen on the left side of the motif, as would be expected.

---

[2] Previously, Kryszkowska (2005a p. 134), in analysing this specific motif, argued that the body of the cuttlefish was made with a solid drill, but after an accurate investigation through the digital microscope, it has been clarified that on the elongated shape there are vertical and parallel lines which could have been left only by a cutting wheel. In this case, the disc of the wheel was a bit wider and rounded, probably to make this type of ellipsoidal shape.

Three other little circles (Fig. 6) have been disposed on the top of the body of the crab and they have been made by the same method of the overlapped drilling. Yet, for each circle, lines have been engraved. For the left circle, five lines can be counted while for the central circle only four, and for the circle disposed on the right, five cuts occur; all are made with the cutting wheel (Fig. 7). Finally, three semicircles surrounding the little circles have been engraved and, the central one, based on the damaged points of the semicircle, must have been engraved before the others which overlap it (Fig. 8). The crab has been made with 8 cuts plus 25 for the ornamental motifs so that the entire figure contains a total of 33 cuts (Figs. 9-10).

Spider (Pl. 13). CMS I No. 464 is in good condition and it is clearly visible that the first cut was made by the combination of two solid drills to make the body of the spider with a circle on the centre of the seal-surface (Fig. 1). Sixteen cuts for the legs have been engraved and they have been made by two strokes of the cutting wheel. The first cuts are those next to the abdomen of the spider and then the others have been interconnected (Figs. 2-3). Then, two palps at the top of the body have been added (Fig. 4) and, to complete the icon, cross-hatching composed of six cuts has been added at the top of the same icon (Fig. 5) and another one composed of three cuts under it (Figs. 6). The spider has been made with a total of 20 cuts so the total number of cuts for this composition is 29 (Figs. 7-8).

Scorpion (Pl. 14). CMS XII No. 216 shows two combined motifs, and the scorpion will be now analysed. To create the scorpion, a first cut made by the cutting wheel with a broad edge has been created to shape its body (Fig. 1). Then, four semicircles have been added on it (Fig. 2). The tail has been added after the creation of semicircles and it is composed by a line made by the cutting wheel plus a semicircle made by a simple tubular drill (Fig. 3). Three lines are located at the top of the body but they are not very visible (Fig. 4). The legs have been made with a cutting wheel on the left (Fig. 5) and, on the right side, it is possible to see the sequence of the cuts (Fig. 6). The two pedipalps have been made by the cutting wheel (Fig. 7). Finally, two circles have been disposed at the upper part of the body to create eyes (Fig. 8). A total of 32 cuts have been counted for the creation of this motif (Fig. 9-10).

Forepart of fish (Pl. 15). CMS XII No. 176 shows two foreparts of fish antithetically disposed. The bodies of the fish have been made by two strokes made by a broad wheel (Fig. 1) and then, on these first two cuts, three lines have been overlapped (Figs. 2-3). The cuts made by the wheel with the broad edge have been contoured by two other lines (Fig. 4). On each forepart, two semicircles have been overlapped by the tubular drill (5). The two eyes have been also made by a small tubular drill (Figs. 6-7).

Finally, plants on each side (Figs. 8-9) of the stone have been engraved and a pattern design composed by four semicircles and four lines has been disposed between the foreparts (Fig. 10). These foreparts of the fish have been made with a total of 18 cuts with 25 cuts for ornamental details, so the total number of cuts is 43 (Figs. 11-12).

Panel v-shaped (Pl. 16). In CMS XII No. 17 the two panels were made first with a cutting wheel with a broad edge (Fig. 1), and then lines were overlapped on them. The panel disposed on the left side presents 10 lines, while the opposite one shows 7 (Fig. 2). To connect the two panels, a semicircle was disposed at the base (Fig. 3). Four semicircles were created using the previous cuts from a tubular drill (Fig. 4). For some of these, it is possible to see the sequence of the cuts (Figs. 5-6). On both sides of the figure, there are six lines (Figs 7-8). At the top of the panels, three parallel lines are engraved (Fig. 9). The last line has been engraved following 12 small perpendicular lines that are more visible on the impression (Fig. 10). Between the two panels, there is a slight cross-hatching composed of five lines (Fig. 11). Finally, this composition presents two plants on both sides of the seal-surface. The plant on the left side is clearer and was created by a first cut of a broad wheel (Fig. 12) and then a thin wheel made straight lines to complete the plant. For the plant disposed on the right side, eight cuts are visible (Fig. 13). On the opposite side, the seal is damaged. Furthermore, it seems from the cast that nine lines are engraved for the plant (Fig. 14). On the far sides, two more lines are engraved (Fig. 15). The panels have 28 cuts with 48 ornamental cuts, so the entire composition has a total of 76 cuts (Figs. 16-17).

Panel (Pl. 17). There are two methods to create the panel motif. One involves the use of only one cutting wheel while the other method implies the use of the cutting wheel with the broad edge. The first example listed below exemplifies the first method.

Jasper CMS XII No. 192 shows two panels which have been made by a thin wheel which made five parallel lines for each panel (Fig. 1). To complete the two panels, four semicircles have been added on each figure (Fig. 2). Between them, a circle and four lines can be seen (Fig. 3). Then, at the top and on the lower part of the seal-surface, an ornamental motif triangular-shaped was composed by seven lines (Figs. 4-5). As the detailed cuts overlapped on the upper part demonstrates (Fig. 6), these ornamental components must have been engraved after the central pattern. On the right side of the seal-surface, five lines and two semicircles have been engraved as decoration (Fig. 7). The fracture on the opposite side of the seal does not allow one to draw a definite conclusion, but traces of a semicircle would indicate that the same decoration could have existed (Fig. 8). Each panel has been created with a total of 7 cuts plus 26 cuts for ornamentals motifs so that the entire composition counts 33 cuts in total (Figs. 9-10).

The Quartz CMS XII No. 171 (Pl. 18) is a similar composition but a different use of the tool can be seen in this motif. In fact, the two panels have been made by two deep cuts of the cutting wheel with the broad edge first (Fig. 1) and then, the engraver proceeded to put lines on them. The effect of this engraving solution is a more plastic figure (Fig. 2).

Double Axe (Pl. 19). CMS XII No. 97 shows a figure created only by the use of the cutting wheel. Two parallel lines have been engraved initially on the centre of the seal-surface (Fig. 1). Then, according to the visible cuts overlapped on the bottom left and on the upper right sides of the figure (Figs. 2-3), the two lines which create the two cutting edges have been engraved (Fig. 4). After this step, the two curvilinear lines have been interconnected to the previous cuts to create two arches in both the upper and the lower part (Fig. 5). It must be noted that on the cutting edge on the right, the cut was not precise and three strokes of the cutting wheel can be counted (Fig. 6). In addition, the arch disposed on the bottom left has been created by straight and little cuts and this confirms that the engraver was quite accurate for the creation of this line (Fig. 7). Two oblique lines decorate the two blades and two others have been disposed on both sides of the handle (Fig. 8). Finally, at the top of the motif, two parallel lines have been engraved. A little cut can be seen on one of these lines but it is not clear if it is a stroke of the cutting wheel or if there is damage on the seal-surface (Fig. 9). A total of 16 cuts made this motif so that the entire composition presents 18 cuts (Figs. 10-11).

Rosette (Pl. 20). In CMS XII No. 157, as can be seen on the centre of the seal-surface, a circle has been created with the combination of the solid drill and tubular drill overlapped (Figs. 1-2). Then, with a very small cutting wheel, 23 straight cuts surround the previous cut (Fig. 3). Finally, seven semicircles conclude this motif (Fig. 4). It is not possible in this case to understand the sequence of the cuts but the motif was made with 32 cuts (Figs. 5-6).

Triangle (Pl. 21). CMS XII No. 202 presents three lines which form a triangle (Fig. 1). The cut that creates the base line of the triangle is more precise than the others. In the other two lines, it is possible to see overlapped lines made by the thinner wheel (Figs. 2-3). The line on the left side of the seal-surface has been elongated (Fig. 4). Then, two semicircles were engraved on both the upper sides of the triangle (Fig. 4). The sequence of these cuts is demonstrated by the detail of the point of the semicircle on the left side, which is overlapped by the circle (Fig. 5). Moreover, there are five lines under each semicircle (Figs. 6-7). The triangle is filled with a dense cross-hatching constituting 18 cuts (Fig. 8).

Under the base of the triangle, there are two semicircles (Fig. 9). Under the semicircle on the left side, four lines are engraved (Fig. 10). In the opposite semicircle, three cuts can be distinguished (Fig. 10). Between the semicircles, two lines made using the cutting wheel are evident. In addition, on both sides of the triangle are made of a couple of lines (Figs. 12-13). Unfortunately, the upper side of the seals is fractured, and this does not allow further comments (Fig. 13). The triangle was created using 24 cuts and the decorative components with 25 cuts, so the total number of cuts is 79 (Figs. 14-15).

Fish (Pl. 22). CMS XII No. 190 shows two fish engraved by the cutting wheel. The bodies of the fish have been engraved first by two straight lines (Fig. 1) and then three fins have been added with a thinner wheel on both fish (figs 2-3).

A beak has been created by one small straight cut on both the heads of the fish (Figs. 4-5). The tails have been created by two small, straight cuts (Figs. 6-7). A bigger fin has been disposed on the body of the fish and positioned on the right side of the seal-surface. Ornamental plants occur and one is located on the upper left side of the seal-surface (Fig. 9), while the other is on the lower right (Fig. 10). In the former, eight cuts can be counted while in the latter one only six. The total cuts for the two fish are 14 while the total cuts of the plants are 15, so the entire composition includes 29 cuts (Figs. 11-12).

Chapter 4 -Appendix 2

The cut style figures

The cut style and its characteristics

In terms of technique, the cut style is seen as the successor to the talismanic style. Regarding the motifs, goats and birds appear together with new motifs such as lions and griffins but the repertoire is limited (Krzyszkowska 2005a, p. 201). The subjects do not present a variety of poses; for example, the lion is usually represented recumbent or in pairs, disposed back to back. In addition, griffins are represented in profile with their wings carved behind their backs. The corpus of the talismanic seals depicts many birds in various forms, and given the strong similarity with the cut style (Krzyszkowska 2005a, p. 202), they are stylistically the hardest to classify.

From the technical point of view, the cut style and the talismanic style use the same engraving technique and both use rotary tools, but the size of the tools is thicker in the cut style (Onassoglou 1985 p. 191). The thicker tools had an impact on the composition of the figures whose forms are much more emphasised. Visually speaking, these motifs are characterised by a great plasticity.

Among the tools, the cutting wheel plays a crucial role and it has been used for both cutting and modelling; as opposed to the talismanic style where it was mainly used for cutting. Some details of the animals such as the back or the neck were marked with contour lines which seem to be a fundamental characteristic of this style. Sometimes contour lines can be also seen in the talismanic motifs (e.g. cuttlefish) but it is not an essential feature of the talismanic style.

Moreover, the cut style involves an exaggeration of the use of drills to make either details or ornamental components, more so than in the talismanic style (Pini 2000, p. 210). The cut style seems to have been developed before the end of LM IB and it continued into LM II (Pini 2000, p. 214; Krzyszkowska 2005a, p. 202) thus overlapping with the talismanic style but continuing later than the latest examples of that style. Because the motifs of the bird and the fish are similar stylistically (Pini 2000, p. 215), there have been problems with classification (Pini 2000, p. 212). I now analyse the motif of the bird, followed by the fish and other figures that can be related to this style.

I think the bird motif is better categorised in three different poses:

- the antithetical pose
- profile pose
- frontal pose

In this latter case, two variations of the position of the wings can be also noted: 1) bent wings and 2) outspread wings.

<u>Birds antithetically disposed</u> (Pl. 24, Figs. 1-6)
CMS XII No. 189 (Fig. 1) shows two birds antithetically disposed. They were engraved by two strokes of a broad wheel and then re-worked through a series of dense and straight lines with a thin wheel. Tail, beaks and legs can be recognised. Finally, two curvilinear lines can be also be noted at their back.

CMS II, 3 No. 357 (Fig. 2) reproduces the same previous structure of two birds.

CMS I No. 446 (Fig. 3) presents a similar composition to the preceding example and, in this case, an extreme use of the wheel is clearly evident.

CMS II, 3 No. 155 (Fig. 4).[3] In this representation, the structure is similar to the birds listed as examples above. The bodies were clearly made by the broad wheel which was used in a continuous way on the bird disposed at the right side of the seal-surface. Fantails were created with a decoration between them.

CMS II, 3 No. 254b (Fig. 5) shows two birds antithetically disposed and this case is different than the aforementioned ones since their shape is more accurate. A broad wheel has been used to first draft their bodies on which the plumage has been engraved by a thin wheel which creates a series of straight lines. The heads have been entirely shaped by a broad solid drill emphasising the rounded forms. In this case the two slight curvilinear lines have been antithetically disposed between their bodies and a circle made by a solid drill has been overlapped on them. Two little lines are visible on both backs of the birds, as well as a slight base-line under the two bodies.

HM 2616 (Fig. 6) shows two similar birds to Carnelian CMS II, 3 No. 254b and they have been engraved with the same method. The only difference is that a palm tree (Catling et al. 1979, p. 66) has been disposed between these birds.

<u>Profiled birds</u> (Pl. 25, Figs. 1-3).
Representation of birds in profile and in a reclined pose showing wide outspread wings has been noted in three cases.

CMS V No. 605 (Fig. 1), Carnelian CMS XI No. 96 (Fig. 2) and Rock Crystal CMS VII No. 164 (Fig. 3). As can be seen, these three birds are very similar and their bodies have been created by a broad wheel. Wheels have been used for the creation of wings that have been detailed and contoured by a thin wheel. The thin wheel completed the rest of the details such as the fantail and the beaks. For the creation of the eyes a broad solid drill has been used to make a semicircle. The two legs are similar but in No. 605 (Fig. 1) only one leg can be seen. Conversely, in the other two birds two legs can be distinguished. In No. 96 (Fig. 2) the articulation of the legs has been created by a circle made by a solid

[3] This motif was previously classified as an isolated motif. However, I think that this figure represents a bird.

drill. The poses of these three birds are unusual in connection with the talismanic style and, at the same time, the technical use of the tools is totally different from the talismanic engraving method. It is very clear that there is a deep attempt at rendering the figures in a much more precise manner, as well as an attempt at modelling many details.

<u>Birds with fully outspread wings</u> (Pl. 26, Figs. 1-17)
CMS IV No. 260 (Fig. 1) shows a front-facing bird with wide and elongated outspread wings. The body and the wings have been created by the use of a broad wheel. Then, a thin wheel has been used to contour and emphasise the details by modelling the bird. The plumage is made by dense straight and precise lines while the tail is created by slight curvilinear cuts. A solid drill has been used to make three circles on both the upper part of the wings and one in the chest of the animal as a decoration, while another circle has been used to create the eye. The beak is also made by a straight and clear line by a broad wheel. As a result, the figure is very clear in all details.

CMS XII No. 162b (Fig. 2) shows a bird whose body has been engraved by a broad wheel and the roundness of the head has been accentuated. The wings are made by the usual scheme to create the upper part by a broad wheel followed by the usual contouring by a thin wheel. A slight fantail has been added to the body and a broad solid drill has made the eye.

CMS III, 2 No. 487 (Fig. 3) presents a frontal bird which has the same structure as the previous ones but with emphasised contouring. In fact, the body, the wings and the lower part of the body have all been outlined by a thin wheel and a thinner wheel has been used to create very dense plumage. The fantail also presents the use of dense lines. Finally, a solid drill has been used to make the eye.

CMS XIII No. 118 (Fig. 4) shows a bird whose body was elongated to create a triangular tail. The wings have been recreated with the usual structure. A tubular drill made a circle for the eye and some ornamental plants have been positioned on both sides of the head. The upper part of the bird is emphasised by the broad wheel but also the heavy use of a thin wheel for the tail is noted.

CMS III No. 488 (Fig. 5) shows a sharp similarity to No. 118 (Fig. 4); however, some differences are noted in the outline of the upper part of the wings. More precision in the creation of the tail can be seen, and for the creation of the eye a solid drill instead of a tubular drill was used.

CMS XII No. 281 (Fig. 6) presents a similar bird but, in this case, a soft stone was used, meaning a different engraving method was used. However, the characteristics of the cut style are seen, for example No. 488 (Fig. 5). The freehand technique did not allow the creation of straight and precise cuts.

CMS II, 3 No. 354 (Fig. 7) reproduces a bird in the cut style. The broad wheel plays a crucial role for the creation of the body of the figure. The upper part of the bird is emphasised by outlining the wings with a thin wheel, as well as making the eye with a broad solid drill. It can be observed that double plumage has been created with the thin wheel which accentuates the entire figure. Carnelian CMS VII No. 259 (Fig. 8) shows a bird whose body is extremely rounded and all characteristics belong to the cut style.

CMS VII No. 259 (Fig. 8) shows a bird whose body is extremely rounded in accordance with the characteristics of the cut style.

CMS VIII No. 57 (Fig. 9) shows a frontal bird with outspread wings. The body of the bird has been created by a broad cutting wheel, while the final part of the body has been contoured by two straight lines from a thinner cutting wheel. An eye has been created by the usual broad solid drill which emphasises the dimensions. The wings are squared and made by a thin wheel, and a fantail completes the figure.

CMS VII No. 122 (Fig. 10). The precision of the cuts suggests we are dealing with rotary tools used on a hard stone. In this case, the body has been drafted by a broad wheel while the lower part has been contoured by two straight lines which accentuate it. The wings are extraordinarily elongated and all cuts are harmonically juxtaposed. For the creation of the tail, judging by the plasticity of the tail in the impression, a first stocky cut has been created by a broad wheel and then it has been worked on by a thin wheel which created straight lines. The head is rounded and the solid drill has been used to make a circle for the eye.

CMS II, 3 No. 355 (Fig. 11) presents a similar composition to the previous example and the wings are outspread and very elongated. The tails have also been emphasised by a series of dense and straight lines while a slight roundness to the head can be seen.

CMS II, 3 No. 194 (Fig. 12) is another case of freehand engraving and although the components are not precise, the cut style characteristics are present. This figure has been well worked and the use of a broad tool can be noted for the creation of the body. For the upper part of the wings, the artisan recreated the typical scheme for the construction of the wings and another stroke of a broad tool has been used for the tail. The rounded head has been created by a broad solid drill.

CMS II, 3 No. 94 (Fig. 13) presents a bird whose head has been emphasised over the component of the body. A broad solid drill has been used for the creation of its eye. A circle has been used to put a decoration on the animal’s chest. The artisan reproduced the typical cut style with outspread wings but not in a symmetrical manner.

CMS II, 3 No. 132 (Fig. 14) shows emphasis on the wings which are very wide and contoured, while a double use of drills can be seen for the head. Both the body and the upper part of the wings have been emphasised.

CMS III No. 489 (Fig. 15) shows a frontal bird with well-engraved outspread wings. The tail has been emphasised and its shape is not precise.

HM 2323 (Fig. 16) shows a frontal bird with outspread wings. The body has been contoured and this has made the figure proportionally bigger. A circle made by a broad solid drill has been posed to make a bug eye while the wings are built according to the usual cut style. The fantail completes the figure. Two trifoliate branches above the wings have been disposed decoratively.

Onassoglou, p. 270 No. 8 (Fig. 17) shows a frontal bird with outspread wings. The description of this figure is based on a drawing in which it is possible to recognise the same characteristics discussed above for the other representations.

<u>Bird with bent outspread wings</u> (Pl. 27, Figs. 1-12)
CMS X No. 318 (Fig. 1) shows a frontal bird with wide, bent outspread wings. Although the body is not emphasised, the wings have been exceptionally worked. In fact, the use of both broad and thin wheels can be recognised. The upper part of the wings reproduces the usual scheme of the cut style but a diversification can be seen for the plumage, which is intensified in both final parts by dense lines. On the upper part of the wings, six circles have been engraved by a tubular drill which has also created a circle for the eye of the animal. The tail is triangular-shaped. Finally, the figure has been surrounded by the typical talismanic ornaments which accentuate the extreme work of the composition.

CMS VIII No. 155 (Fig. 2) presents a bird with bent, outspread wings. The two wheel types played an important role in the creation of this motif. In fact, the body and the wings have first been drafted by a broad wheel while the thin wheel was used to make the typical contours modelling the figure. The same tool has been used to complete details such as the tail and the plumage. On the head a very large circle has been engraved by a solid drill which further accentuated the proportion of the figure.

CMS VIII No. 158 (Fig. 3) shows a frontal bird whose body is not so emphasised. The wings are outlined by a thin wheel while the plumage is not made by lines that are overlapped and present different orientations. A fantail has been added to the body and the head has been emphasised by a large circle.

CMS X No. 277b (Fig. 4) shows, as seen for the previous figure, a bird with large bent, outspread wings. The body, although created by a broad wheel, is not emphasised as well as the wings are. The wings are quite elongated on both sides of the seal-surface while the dense plumage is symmetrical. To complete the figure, a fan-shaped tail has been added, as well as the typical large circle for the head.

CMS II, 3 No. 254a (Fig. 5) presents a particular use of the broad wheel. The entire figure has been emphasised accentuating its plasticity as result of the impression on the seal. The creation of the wings is very peculiar. In fact, the upper part, which was made by a broad wheel subsequently outlined by the thin wheel, has been connected by two strokes of the broad wheel on both sides. Then, on these cuts, a series of lines have been engraved rendering this subject more plastic. The proportion of the figure is accentuated by the creation of the fantail, as well as by the large circle used for the eye.

CMS VI No. 273 (Fig. 6) shows a frontal bird engraved accurately with emphasised wings. The usual rounded head with the circle made by a tubular drill can be seen and a sort of fantail with a curvilinear line at the base completes this bird.

CMS I No. 146 (Fig. 7) shows a frontal bird with outspread wings, a voluminous rounded head and an eye created by a solid drill. The entire figure has been well emphasised.

CMS VII No. 69 (Fig. 8) shows a frontal bird with a rounded body. The wings have been made with the usual method of the broad and thin wheels. On the wings are decorative circles made by the solid drill. As a result, the tail is flat.

CMS I No. 470 (Fig. 9) presents a frontal bird with bent, outspread wings. Its body has been created by a straight cut with a broad wheel. For the creation of the wings the canonical scheme can be seen while the tail has been created by a series of lines.

CMS II, 3 No. 181 (Fig. 10) is partially fractured on one side. The body of the bird has been made by a broad wheel. The creation of the wings repeats the usual scheme and, in this case, circles have been engraved on them as ornaments. A fantail shape is represented. On the head a beak is represented, as well as an eye made by a solid wheel. General circles emphasise the entire figure.

CMS III No. 490 (Fig. 11) shows a bird with a rounded and voluminous head completed in detail by a solid drill to make the eye. The outspread wings follow the stylistic rules of the cut style.

CMS IX No. 62 (Fig. 12) shows a freehand engraving technique. The bird has been represented modelling the wings as usual. The body has not been emphasised and a fantail has been added to complete the icon.

<u>Fish antithetically disposed</u> (Pl. 28, Figs. 1-15)
CMS IV No. 169 (Fig. 1) shows two antithetical fish whose bodies have been drafted first by a broad wheel and subsequently their details have been accentuated by a thin wheel while the tubular drill has been used to make the eyes. The proportions of the heads have been exaggerated and, generally, both fish have been worked by the use of the wheel.

CMS IV No. 172 (Fig. 2) shows two fish antithetically disposed. The upper parts of their bodies have been modelled and the proportion of the heads is quite emphasised. The lower part of the bodies has been contoured. The fins have been made by a series of lines which are not very well defined. Finally, both mouths have been underlined by the wheel while the eyes have been created by a tubular drill. Both fish present tails.

CMS XII No. 185a (Fig. 3) shows two fish antithetically disposed and similar to the previous ones, particularly for the creation of the fins which have been contoured.

CMS V No. 179 (Fig. 4) represents a couple of fish. Their bodies have been created by a broad wheel and refined by a thin wheel. The heads have been emphasised by the use of the tubular drill which made circles for the eyes subsequently contoured by a semicircle. A series of straight lines contour the figure making this representation visually very impressive.

CMS XI No. 109 (Fig. 5) shows two fish antithetically disposed. The bodies have been engraved by a broad wheel. Two fins have been elongated from the heads and the dorsal fins are detailed and contoured by a thin wheel. The other two fins have been contoured by straight lines. Moreover, particular emphasis has been given to the heads on which two semicircles have been engraved. Finally, straight lines surround the bottom part of the bodies.

CMS IX No. 72 (Fig. 6) is the most remarkable example of representation of a fish in the cut style. Two fish antithetically disposed have been represented by bodies that have been created by a broad wheel. The rounded head is dimensionally very impressive since it was emphasised by the use of a broad solid drill which created two huge rounded eyes.

CMS III No. 336 (Fig. 7) present two fish antithetically disposed. The bodies of the fish were contoured and the fins were made by straight lines by a broad cutting wheel. A solid drill was used to create the eyes whose dimensions are quite emphasised. A cross-hatch pattern with upper and lower contoured lines was also positioned between the two figures. This pattern was created by a broad cutting wheel, dimensionally accentuating the entire composition.

CMS II, 3 No. 12b (Fig. 8) shows two antithetical fish very well worked and symmetrical. The bodies have been contoured and the fins modelled by the cutting wheel. In this example, the eyes were created by a tubular drill and a grid was juxtaposed between them.

CMS IX No. 60 (Fig. 9) shows two antithetical fish. Their bodies were contoured and interconnected by fins. The fins were modelled by the cutting wheel which created a series of straight lines.

CMS I No. 457 (Fig. 10) shows two antithetical fish which are not very symmetrical. A slight attempt at modelling the figures can be seen. Both bodies were contoured and the fins were modelled by the cutting wheel. In this example, the eyes were dimensionally emphasised by a solid drill. Between the eyes, a grid was disposed.

Sealing CMS II, 6 No. 133 (Fig. 11) shows two antithetical fish with two emphasised eyes. The bodies were contoured by lines.

CMS III No. 335 (Fig. 12) presents two antithetical fish and their bodies were clearly contoured by lines. An attempt at modelling the dorsal fins can be noted.

CMS IV No. 187 (Fig. 13) presents two antithetical fish and the upper part of their bodies was modelled by the use of the tubular drill. The shape of the fins was modelled and an extreme use of the cutting wheel was used to fill out the seal-surface.

CMS III No. 334 (Fig. 14) shows two fish whose bodies were drafted by the use of the broad cutting wheel. It seems that the figures were constructed to indicate natural movement. Contour lines can be seen for the fins and a series of lines disposed around the body of the fish accentuate the modelling of the figures.

Unclear CMS X No. 116 (Fig. 15) shows two fish in which contour lines are visible in both the bodies and the fins. Although the figures are not emphasised as a result, this technical method is reminiscent of the characteristics of the cut style.

<u>Fish in a frontal pose</u> (Pl. 29, Figs. 1-12)
CMS XIII No. 143 (Fig. 1) shows a single fish whose body proportion is exaggerated due to the use of the broad wheel. The two lateral fins have also been engraved with a broad wheel and subsequently detailed by lines. The lower part of the body of the fish has been surrounded by a series of lines. It is clear that the artisan was trying to create a fish by emphasising its proportions.

CMS II, 3 No. 308c (Fig. 2) shows a single frontal fish and its body has been outlined by two straight lines on both sides. The fins have been heavily worked and on the impression of the seal it is possible to note a great plasticity. A semicircle was juxtaposed on the head of the fish and the characteristics of the cut style seem to be evident.

CMS VI No. 249 (Fig. 3) shows a single fish whose body dimension is massive since it was created by a broad wheel. The fins were created by a thin wheel and elongated on both sides of the body. The fins were subsequently filled by straight lines.

CMS VI No. 250 (Fig. 4) shows a frontal fish with emphasised dimensions. The body was contoured by a cutting wheel and the fins were created by straight lines and were contoured. The figure is somewhat more detailed than other figures in this category, with the addition of a mouth and a wide-open eye created by a broad tubular drill.

CMS IX No. 57 (Fig. 5) represents a frontal fish typical of the talismanic style; however, the representation of the fins is more accurate and emphasised. Their shape, in fact, seems to be closer to the representation of wings of birds in the cut style.

CMS XIII No. 119 (Fig. 6) seems to represent a frontal fish in the talismanic style but, as seen in the previous example, the shape of the fins seems to be closer to the representation of the wings of birds in the cut style.

CMS XII No. 150b (Fig. 7) represents a frontal fish with a slight torsion of the body which is something unusual for the talismanic style. The fins are emphasised, which is reminiscent of the cut style. Moreover, the final part of the tail presents contour lines.

CMS XIII No. 120 (Fig. 8) represents a fish with a torsion of its body. Emphasis has been given to the fins, and small details created by little strokes of a thin cutting wheel can be seen in the lower part of the body.

CMS XI No. 279 (Fig. 9) shows similar characteristics with the previous figure with the only difference being the absence of torsion of the body. The fins are modelled as in the previous example.

CMS II, 3 No. 262 (Fig. 10) represents a fish with an extreme torsion of the tail which is emphasised by multiple lines. The shape of the wings seems to be modelled similarly to the wings of birds in the cut style. Moreover, the use of the drills can be noted for the creation of details which make the figure further modelled.

CMS X No. 288 (Fig. 11) represents a fish very similar to the previous figure but it is less accurate.

CMS XII No. 198 (Fig. 12) represents a fish which actually seems to be a bird. However, the fins have been emphasised by the use of the broad cutting wheel and by the further strokes of lines engraved on the first cuts. In addition the fins and body present contour lines.

Fish in a profiled pose (Pl. 30, Figs. 1-13)

CMS I No. 436c (Fig. 1) a single profiled fish has been represented and the use of the broad wheel is prevalent. This proportion of this fish is massive and the fins have been engraved with a broad wheel first, followed by a series of lines.

CMS II, 3 No. 375 (Fig. 2) shows a fish created with a broad wheel which has emphasised the proportions. The dorsal fin was contoured by a thin wheel making it larger. Lines can be seen on the dorsal part of the fish. The decoration under the fish has been emphasised.

CMS III, 2 No. 326 (Fig. 3) shows another massive fish and the same method of contouring in the lower part of the fish can be seen.

CMS II, 3 No. 34 (Fig. 4) shows the same method as the previous one, but in this case the use of the thin wheel is visible. All details have been dramatically emphasised by the use of the broad wheel.

CMS III, 2 No. 331 (Fig. 5) shows a fish whose body has been created by a broad wheel. Its fins have been elongated and filled by a thin wheel. The proportions once again have been emphasised.

CMS II, 3 No. 209 (Fig. 6) presents a profiled fish with an accentuated body made by the cutting wheel and subsequent overlapping lines. The fins were created by a series of lines, a beak models the figures and, finally, a semicircle created by a broad tubular drill has been disposed on the head.

CMS I No. 409 (Fig. 7) shows a multiple fish whose bodies have been heavily worked and contoured by a cutting wheel.

CMS X No. 94 (Fig. 8) presents a fish whose body was first drafted by a broad cutting wheel and then modelled by a thinner cutting wheel. A semicircle created by a tubular drill created the eye and emphasises the entire figure.

CMS XII No. 186a (Fig. 9) shows a fish with a body contoured by lines and its fin modelled by the extreme use of the cutting wheel.

CMS III No. 325 (Fig. 10) presents a fish with one fin heavily modelled by the cutting wheel and the other one engraved by the broad cutting wheel.

CMS IX No. 59 (Fig. 11) presents a fish whose body is emphasised by the use of the broad cutting wheel and by the contouring lines.

CMS X No. 96 (Fig. 12) shows a fish whose body was created by the broad cutting wheel and the fin is surrounded by lines.

CMS II No. 220 (Fig. 13) presents a fish with emphasised fins contoured by lines. The lower part of its body presents a series of lines which render this figure quite detailed with the absence of schematisation.

<u>Other cut style motifs</u> (Pl. 31, Figs. 1-8)

Lion

CMS VI No. 106d (Fig. 1) shows a lion in a recumbent pose. The broad wheel made the body through deep cuts on the seal-surface so that the result is a plastic animal. The cuts are harmonically juxtaposed and it is possible to distinguish three orientations of the wheel. The head has been detailed by the creation of the typical mane made by dense cuts engraved by a thin wheel. Semicircles made by the tubular drill can be seen.

CMS II, 3 No. 292 (Fig. 2) does not show a clear animal. The entire body of the animal, except the leg, has been engraved by a continuous and curvilinear use of the wheel. The posterior limb has been created by a combination of solid and tubular drills and then the wheel elongated the leg. The chest has been also emphasised by a circle and the body has been also accentuated by the contour lines, particularly for the back. The head has also been modelled by the wheel. The use of the tubular drill is visible as are the semicircles used for the creation of a sort of mouth, the paws and the end of the tail. Care of the details can be also noted for the creation of the nostril with a small solid drill. As seen, the use of the tools and the general conception of this composition do not allow us to evaluate it as talismanic.

Dragon

CMS III, No. 320 (Fig. 3) shows a dragon whose cuts are similar to those seen for the lion in CMS VI No. 106c and it seems to have a similar pose. Here, the anterior and central part of the body have been engraved with the continuous use of the wheel while a different orientation can be seen for the creation of the final part of the body. The anterior part of the body has been clearly modelled and as a result the chest is rounded while the final part of the body has been created by two juxtaposed cuts with a different orientation. It is possible to recognise slight lines of contour under the central part of the body, at the back of the neck and on the posterior leg. The details such as the neural spine, the little legs and the semicircles on the chest do not model the figure as talismanic in style.

CMS XII No. 290 (Fig. 4) shows another representation of a dragon and its body is modelled in the posterior part while the neck has been created by a single cut interconnected to the rest of the body. The cutting wheel has been used to draft the animal and to model it with lines visible, for example for the neck. The neural spine has been created on the upper part of the body with a thin wheel which has also made the legs. The tail has been detailed and intensified by lines. To complete the dragon, six circles made by the tubular drill have been engraved on the body of the animal. The composition that results is meticulously worked in detail by a different use of rotary tools.

Bucranium

CMS VII No. 34 (Fig. 5) shows a bucranium whose proportions are massive and plastic. The engraving is precise and detailed as seen for the two modelled horns made by the wheel. The creation of the eyes is peculiar and it is clear that the purpose of the artisan was to pay attention to the fine details.

CMS II, 2 No. 283 (Fig. 6) shows a bucranium with emphasised cuts. The top of the head has been emphasised by a circle.

Spider

CMS III, 2 No. 289 (Fig. 7) shows a dorsal view of a spider meticulously worked. All cuts are perfectly juxtaposed and slight broad tools have been used. Plasticity can be clearly seen in the seal-impression. Between the upper legs a series of straight lines have been inserted which is similar to the methods of the feathers of birds in the cut style. Here, two contour lines were used in the upper part of the body previously drafted by a wheel. Lines as decoration have been also overlapped on the lower part of the circle which represents the abdomen. The proportions together with the rest of the details emphasise this spider which can be considered made in cut Style.

Scorpion

CMS VI No. 228 (Fig. 8) shows a different creation method for this motif. In this seal two antithetical scorpions have been engraved. The use of the broad wheel is visible on the seal-impression because it gives plasticity to both bodies. A thin wheel has been used to make a curvilinear tail. The bodies of both scorpions have been densely worked with straight lines and on both sides of the bodies straight contour lines can be noted.

Chapter 4 - Appendix 3

Naturalistic/realistic motifs

Birds (Pl. 32, Figs. 1-23).

CMS VII No. 44 (Fig. 1) shows a left profiled bird. Although the tools are the same, the cutting wheel in this case was used in a different manner. In fact, the wheel was used to make curvilinear lines in a continuous motion and this is clearly visible in the creation of the entire body of the figure. The wings have probably been made with a broad wheel while the details which make the feathers have been engraved by a thin wheel. The legs of the bird have been created with straight lines by the wheel and are modelled. This particular use of the wheel, as well as the composition method, offers a different style which cannot be defined as schematic but rather well modelled and detailed. Thus, it can be classified as naturalistic.

CMS VII No. 165 (Fig. 2) presents another left profiled bird. The body and neck of the bird have been created with only a curvilinear and continuous line made by a broad wheel which modelled the entire animal. The wing has been represented outspread through the creation of straight lines which also create the fantail. A base line can be also seen. The head has been modelled and detailed through the use of a tubular drill which created the eye, while a thin wheel was used to create the beak. Overall, the plasticity of its body and all the details make the figure very naturalistic.

CMS V No. 238 (Fig. 3) shows the same use of the wheel seen for the previous representations. This seal shows a couple of birds whose bodies have been created by a continuous and curvilinear use of the wheel. The posterior part of their bodies is rounded while the necks are quite curvilinear. The tubular drill, creating a perfect circle, does not make an eye but it creates a rounded head completed by the beaks created by straight lines. Straight lines have been used for the creation of the legs and for the dense plumage. This representation of the wings may be an attempt at creating movement in these subjects. Somehow, both birds seem connected each other and the whole composition accentuates the naturalistic view of the composition.

CMS II, 3 No. 180 (Fig. 4) shows, once again, a couple of profiled birds disposed face to face and standing on a couple of branches. Dense plumage has been created by a cutting wheel and the same tool has been used to complete their bodies. The rounded heads have been created with a tubular drill and wheel. The heads are detailed and rounded and the general composition shows these two birds interacting with each other and also inserted in a sort of narrative backdrop. These characteristics are totally absent in the representation of the talismanic style and they can be considered naturalistic.

CMS VI No. 257b (Fig. 5) shows a profiled bird whose neck is turned to the right. It has been interpreted as an owl. The figure appears deeply plastic so the use of a broad wheel is confirmed. Conversely, a thin wheel has been used to create dense plumage composed by straight lines. Two huge eyes complete the bird giving a naturalistic trait to its head. The pose of the bird together with all these meticulous characteristics render this subject naturalistic.

CMS I No. 150 (Fig. 6) shows a bird with outspread wings which is reminiscent of the pose of a canonical talismanic bird. However, it must be noted that the body of this bird has been well modelled through the cutting wheel which created a curvilinear body very visible in the upper part of the body which is completed by a rounded head. Its wings are also created by a continuous use of the wheel and the plumage consists of straight lines. A modelled fan-shaped tail and legs can be also seen. In this case, although the pose of this bird is reminiscent of a talismanic bird, the use of the wheel is different and it is clear there is an attempt at modelling the subject. Thus, this representation can be interpreted as naturalistic.

CMS VI No. 258 (Fig. 7) shows a similar composition and it presents a frontal bird with outspread wings. The continuous and curvilinear use of the cutting wheel is recognisable for the creation of the entire body, which as a result is plastic. The figure is completed by a rounded head. On its neck is visible a curvilinear decoration, made, once again, by the cutting wheel, yet the outspread wings are created with two curvilinear lines on both sides of the body and the plumage is created by straight lines. Legs are also present on the lower part of the body.

CMS XII No. 141 (Fig. 8) shows a frontal bird with outspread wings. The body has been created by a broad wheel through one straight and deep cut and it has been completed by adding the tail made by a group of curved lines which create a sort of torsion in the bird's pose. The head is rounded and it has been detailed with a beak and one eye. To the body have been added two straight cuts to represent the legs and the tail was made by a series of lines. The wings are modelled and they were created by a broad wheel while the plumage has been attached to the first previous cuts. The broad wheel helped to render this figure plastic and modelled giving it a naturalistic effect.

CMS XII No. 150a (Fig. 9) shows a left profiled flying bird whose body has been modelled. Clearly its pose is too unusual to be stylistically categorised as talismanic and all the detailed components of the figures (such as the rounded head) present naturalistic characteristics. The outspread and curved wings are very well rendered and the proportions are well built. The tail is curved and on the breast of the bird, a rounded decoration likely made by a solid drill is surrounded by a curvilinear and continuous line, but next to the beak a little straight cut has been engraved so it is hard to interpret. Overall, this bird presents a harmonic composition and the figure is very well rendered and modelled, so it is a naturalistic figure.

CMS II, 3 No. 232 (Fig. 10) and Carnelian CMS II, 3 No. 269 (Fig. 11) show two similar birds. No. 269 shows a right profiled bird with elongated neck which is turned back with a rounded body. It is not clear which tool has been used to obtain this rounded effect. A rounded head has been created by the use of the overlapped drills and an opened beak has been created by a thin wheel. The rest of the details have been created with straight lines visible for wings, tail and legs. The pose of this bird is close to a real bird so this figure can be considered as naturalistic although talismanic ornamental components surrounding the bird persist.

The same engraving principle can be recognised for the creation of the bird in No. 232. This seal shows a left profiled bird with the neck turned back. The body of the animal is not very clear but it is very close to the previous one. The neck has been created by a curvilinear and continuous line while the rounded head has been shaped by a tubular drill. The wings have been created by four separated straight cuts by a cutting wheel. Plants have been accurately engraved. One is located on the right and presents two strokes of a solid drill, possibly representing fruit. This bird is inserted in a sort of “bucolic” context so that its pose and the rest of the details of this entire composition appear naturalistic.

CMS IX No. 61 (Fig. 12) shows a frontal bird with outspread wings. The body has been created by a straight cut while the wings have been contoured by a thin wheel and they are not symmetrical as a result. Finally, the tail is fan-shaped. To judge this icon, it is necessary to look at it in its entirety and in this case the naturalistic style is dominant although the pose is the same as that of a talismanic bird.

CMS IV No. 257 (Fig. 13) shows two birds, one of them is a flying bird with an extremely elongated neck and modelled wings. The other bird, disposed under it, presents a curved neck and a very rounded body. Both of birds present naturalistic features.

CMS II, 6 No. 116 (Fig. 14). A couple of birds in an antithetical pose with elongated curved neck and rounded body are represented. The tails have been slightly curved and the whole composition is characterised by an opposite torsion of the two birds.

CMS I No. 213 (Fig. 15) repurposes the same representation of the preceding birds so the composition is naturalistic.

CMS II, 6 No. 123 (Fig. 16) presents a left profile bird with modelled body which was made by a broad wheel used in a continuous and curvilinear manner. It presents a rounded head, outspread wings and a fantail that are very naturalistic.

CMS VS1A No. 165 (Fig. 17) presents a similar bird as seen in the previous example and it shows a right profile bird whose body is quite modelled and rounded. The outspread wings are well detailed and proportioned. The legs are visible and torsion is noted for the creation of the tail which is curved to the bottom left of the seal-surface.

CMS II, 6 No. 277 (Fig. 18) is a frontal bird with outspread wings. The lower part is not visible. However, it seems that both its body and the wings have been naturalistically modelled.

CMS II, 6 No. 169 (Fig. 19) shows a naturalistic profile of a flying bird with outspread wings and an elongated tail.

HM 1034 (Fig. 20) a clear naturalistic flying bird can be seen in this narrative composition.

CMS II, 3 No. 114 (Fig. 21) presents a bird inserted in a narrative scenario making the composition naturalistic.

CMS II, 2 No. 43 (Fig. 22) shows a naturalistic profile of a bird with an outspread wing next to a naturalistic plant.

CMS III No. 495 (Fig. 23) shows a couple of naturalistic birds and a naturalistic fish.

Fish (Pl. 33 Fig. 1-2).
CMS VI No. 257a (Fig. 1) shows a fish rendered plastically. This characteristic was created by a broad wheel. The rest of the details such as the fins and the gills are quite realistic. To complete the subject, an eye was made by a tubular drill. The mouth is open and it seems very naturalistic. Overall, the proportion, the plasticity and the meticulous details visible in this figure accentuate its naturalistic anatomy.

CMS X No. 286 (Fig. 2) shows the same accuracy seen for the previous example and this seal presents a flying fish. Also, in this case a wheel was used for the creation of the body of the fish. The wings are emphasised while the rest of the details, for instance head of the fish, are well juxtaposed and modelled naturalistically.

Naturalistic wild goats (Pl. 34 Figs. 1-6)
CMS II, 3 No. 153 (Fig. 1) shows a wild goat in profile whose body does not present the usual three circles and, in fact, only one is slightly visible on its posterior leg. The use of the circle creates anatomically proportioned musculature of the leg which has been entirely modelled by the wheel. In the anterior part of the animal there is also the attempt

at modelling both the body and the head so that the final result of the figure is quite naturalistic.

CMS X No. 113b (Fig. 2) presents a goat sharing the same modelling features seen in the previous case. In this case, the same well-proportioned musculature occurs and the creation of the animal’s genitalia as an additional detail can be seen.

CMS III, 2 No. 317 (Fig. 3) shows a goat in profile clearly made by a continuous and curvilinear use of the wheel. The legs were created by the same tool and a peculiar care can be noted in the posterior part of the figure since the legs are anatomically well modelled. The neck of the goat is elongated and the rounded head was created by the tubular drill.

CMS XII No. 195 (Fig. 4) shows a quite naturalistic wild goat. The use of the wheel is clear while the use of drills may be assumed. The body was drafted entirely by the wheel and, most likely, circles must have been used on its body according to the significant plasticity visible on the seal-impression. It is not possible to say much on the typology of the drills because the tool marks have been smoothed away. Overall, the figure is well proportioned and, for this reason, it can be stylistically defined as a naturalistic goat.

CMS VII No. 247 (Fig. 5) shows a goat in which the use of the drill is still recognisable but not clearly visible, particularly in the central part of the body. In this case, the tool marks indicate a clear influence of the talismanic style for the construction of this figure but the final result is naturalistic.

The sealing CMS II, 6 No. 59 (Fig. 6) shows a representation of a naturalistic goat. The entire body is modelled and well proportioned. The use of drills may be involved although their marks are not visible. In the posterior leg the natural musculature of the animal is emphasised. The cutting wheel created a curvilinear detail disposed on the breast which is connected to the modelled head of the goat. This detail further increases the naturalistic characteristics of the representation.

Other naturalistic motifs (Pl. 35, Figs. 1-6)

CMS XIII No. 62 (Fig. 1) presents an unusual structure to be defined as talismanic. As can be seen, all details have been juxtaposed harmonically, the legs are well proportioned and the claws were represented naturalistically in detail.

CMS VI No. 225 (Fig. 2) presents a crab with an unusual body structure. The use of a broad wheel must be assumed, based on the shape of the body, as well as the little straight lines surrounding the body. The legs seem to have been created by straight lines and the claws are rendered naturalistically.

Both examples present a series of characteristics which contrast with traditional representation of the talismanic crab motifs and, for this reason, they cannot be defined as talismanic figures.

CMS III, 2 No. 507a (Fig. 3) shows a scorpion which is not made according to the classic talismanic scheme. In fact, it can be clearly seen that the body is rounded and it seems very naturalistic, yet the legs are not made by the usual two straight cuts. The two claws and pincers were made by one curvilinear cut on both sides of the head. Finally, the tail is made by a curvilinear cut of the wheel. Traditionally, the talismanic scorpion presents a curved tail but it is usually created by the wheel which creates a straight cut, followed by a semicircle made by the tubular drill.

CMS IV No. 177 (Fig. 4) although the stone is broken, the figure is a scorpion. The figure motif is represented in detail and its dorsal part is very naturalistic.

CMS I No. 436a (Fig. 5) shows a pig and it can be considered as one of the best examples of how a different use of the tools can create a different style. The pig’s body was engraved by the broad wheel and then contoured by a thin wheel. The same tool has also been used to create the legs and the rest of the details, such as a typical pig’s tail and bristles disposed on the upper part of its body. Anatomically speaking, the posterior part of the animal’s body as well as the head are well proportioned. Overall, this figure is undoubtedly naturalistic.

CMS IV No. 42D (Fig. 6) shows a dragon in a profile pose. As a result, the body of this figure is plastic. The cutting wheel created both the body and the tail in a continuous motion. Later, the legs of the figure were added. Overall, the figure appears to be more naturalistic than talismanic.

Motifs with realistic characteristics (Pl. 36, Figs. 1-5).

CMS VI No. 258b (Fig. 1) shows a jug and, although the influence of the talismanic style is still visible, the details are clearly rendered differently. In fact, the neck, the foot and the handle are modelled so this emphasises the realistic characteristics of a real jug.

CMS I No. 114 (Fig. 2) shows a jug with an emphasised belly. The rest of the details such as the foot, the neck and the handle are well juxtaposed. This figure does not allow one to specify the method used to create the belly as in the talismanic style. Yet, the creation of the handle is very peculiar since the wheel had a crucial role for the creation of the curvilinear line. The shoulder is underlined by a stroke of a cutting wheel which intensifies its realistic features. Overall, this representation cannot be considered stylistically talismanic but, rather, it can be considered realistic.

HM 2343 (Fig. 3) is a three-sided prism and it shows two motifs on two sides. On one side an amphora is represented and its characteristics are reminiscent of the talismanic style. However, this subject was extremely well modelled by the wheel in detail so it seems much more realistic. Moreover, side b (Fig. 4) of the seal shows a double axe made by the same detailed system seen for the previous figure and this means that the result is a stylised and realistic axe (Fig. 4).

The sealing CMS II, 8 No. 54 (Fig. 5) shows a double axe whose blades are carefully worked and very well stylised. This type of representation is quite different than the usual schematic representation of a talismanic double axe which often presents one or two vertical lines in the central part of the seal-surface. Yet, in this case, the artisan made two perfect semicircles to represent the blades using both half sides of the seal-surfaces through the continuous use of the cutting wheel. The two were densely covered by cross-hatching.

Chapter 4 - Appendix 4

Eclectic style

Birds (Pl. 37 Figs. 1-22).

CMS I No. 406 (Fig. 1) shows a bird whose pose is reminiscent of the talismanic style, but its body as well as its head are naturalistically modelled. The wings are linked to the usual composition of birds in the cut style.

CMS VI No. 274 (Fig. 2) is unfortunately damaged, but considering the still visible details this seal seems to show a frontal bird with outspread wings reminiscent of a typical talismanic style pose. The body and the head are modelled and naturalistically rendered. The wings are reproduced in the cut style scheme. It seems also that a leg was created on the bottom left of the seal-surface.

CMS XII No. 254 (Fig. 3). According to the engraving, we are not dealing with rotary tools but with the freehand engraving technique as the cuts are deep and unclear. A front-facing bird with outspread wings is represented and, looking at both the head and the beak, it seems that they are naturalistically modelled. The curved wings are not axially symmetric and two external lines were elongated making a curved effect. Finally, the tail is also slightly curved.

Generally speaking, the pose is reminiscent of the talismanic style, the modelled head and tail seem to be close to the naturalistic style while the wings are comparable to the cut style.

CMS II, 3 No. 356 (Fig. 4) must be a soft stone based on the cuts which seem to be made by the freehand technique. The pose of this frontal bird with outspread wings is reminiscent of a typical talismanic bird, but the creation of the head presents modelled features. The body does not allow one to see the separation from the tail, which is represented by slight curvilinear lines. The wings are axially symmetrical and the two external lines are extremely elongated. The use of a solid drill, which left a circle disposed on the neck as decoration, is reminiscent of the ornamental characteristic of the cut style.

CMS VII No. 144 (Fig. 5) shows the use of freehand engraving. The entire composition is not precise and the body and the head are not axially symmetric. The same imprecision can be noted for the wings. The head is modelled and the eye was created by a solid drill. The tail is triangular-shaped and the lines give it a fantail form.

CMS III, 2 No. 507 (Fig. 6) shows a frontal bird with outspread wings engraved freehand. The body was created with a straight line which can be stylistically linked to the talismanic style, yet the head emphasised by a circle is reminiscent of the cut style as are the wings. The tail is triangular and on its base is a series of straight lines. These schematic cuts are clearly connected to the talismanic style.

Sealing CMS II, 6 No. 114 (Fig. 7) shows a frontal bird with outspread and elongated wings. The upper part of the body is naturalistically modelled while the wings were created according to the rules of the cut style.

Sealing CMS II, 6 No. 113 (Fig. 8) shows a frontal bird with outspread wings. Some details such as the legs are linked to the naturalistic style while the wings seem to indicate a clear relation to the cut style. Decoration can also be seen on the head and a circle can be noted.

CMS IS No. 169b (Fig. 9) shows a frontal bird which is the usual talismanic pose. However, the central part of the body was emphasised by decoration created by the combination of the solid and tubular drills. The emphasis can be related to the cut Style. The head and the tail were naturalistically modelled by a thin wheel and a solid drill created a small circle for the eye. The shape of the wings can be connected to the cut style.

CMS XI No. 327 (Fig. 10) represents another case of the eclectic style. This seal shows a frontal bird with a modelled head, wings related to the cut style. Schematic details such as the body and the tail are reminiscent of the talismanic style.

CMS XII No. 255 (Fig. 11) and Serpentine CMS II, 3 No. 148 (Fig. 12) (although this latter example shows a profiled bird) are very similar.

CMS VI No. 248 (Fig. 13) shows two birds antithetically disposed. It would seem that for the creation of the body, first two slight strokes were made by a broad wheel and subsequently these two cuts were re-worked by a thin wheel which created lines. The structure of the wings is reminiscent of the cut style, while a clear attempt at modelling the heads is clearly linked to the naturalistic style. In fact, it is not a coincidence that these birds are interpreted as owls. Basically, in the composition a certain degree of schematisation is present and for this reason one can conclude the influence of the talismanic style.

CMS XII No. 219 (Fig. 14) shows a frontal bird with wide outspread wings. Considering its structure, it can be said that the body, engraved with a broad wheel, and the emphasis given to the rounded and detailed head, are reminiscent of the cut style, but the wings present a sharp inclination to the naturalistic style. Another connection to the cut style is the use of a circle on the upper part of the wings. Overall, this icon is influenced by the cut and naturalistic styles.

CMS I No. 469 (Fig. 15) shows a frontal bird with outspread wings. The body is schematically represented and for this reason is reminiscent of the talismanic style. Conversely, the wings present analogies with the cut style. Given these characteristics, this motif can be considered as eclectic.

CMS X No. 147 (Fig. 16) was created by the freehand engraving technique. The body of the bird was not engraved by a defined straight cut but it is evident that the chest was slightly modelled. A beak was added to the head through a curvilinear cut while a circle creating the eye was made by a solid drill. The wings are modelled and comparable to the cut style. A fantail and legs complete the figure. Essentially, in this motif a clear schematisation is present which coexists with many details connected to other styles.

Sealing CMS II, 6 No. 110 (Fig. 17) shows a bird in a frontal pose. Its body is remarkably modelled and the head is rounded. The wings are modelled by the use of the cutting wheel but the plumage is not visible. A fantail completes the figure.

CMS III, 2 No. 484 (Fig. 18) The head is naturalistically modelled while the creation of the wings is clearly connected to the cut style. The fan-shaped tail was created with more lines which are hard to distinguish.

CMS III, No. 483 and CMS III, 2 No. 482 (Figs. 19-20) present similar characteristics with the previous example, such as the shape of the heads and the fantails. In both of them the engraver used a curvilinear line to create the wings, which is clearly related to the cut style. The head and the tail are extremely well modelled.

Sealing CMS II, 6 No. 111 (Fig. 21) is a frontal bird whose dimension is massive. The wings are reminiscent of the cut style and the presence of the legs disposed on the lower left side of the sealing is connected to the naturalistic style. The head is not clear so nothing more can be noted.

Sealing CMS II, 6 No. 112 (Fig. 22) shows a frontal bird and, dimensionally speaking, is characterised by plasticity. Its tail is turned and the body looks quite naturalistic. However, the wings are represented schematically which is a characteristic of the talismanic style.

Wild goats (Pl. 38, Figs. 1-5).
CMS IX No. 103 (Fig. 1) shows a wild goat and on its anterior part the use of drills is visible, meaning that the marks were not smoothed away as in the talismanic style. Conversely, the posterior part of the body of the goat appears naturalistically modelled.

CMS XIII No. 144 (Fig. 2) shows the same characteristics seen in the previous example. In fact, the presence of the circle is only in the anterior part of the body, while the rest of this goat has been created with the cutting wheel. The posterior legs have not been perfectly modelled while the anterior legs are made by two straight lines.

CMS VI No. 247 (Fig. 3) shows a goat which is analogous with the previous example. The tool marks of the tubular drills are recognisable for the body of the animal, as well as in the central part of the figure. The posterior legs of the animal were naturalistically modelled, as was the head. Although the circles are still visible, the whole body seems to be modelled. Thus, this motif clearly shows the coexistence of both talismanic and naturalistic characteristics.

CMS XII No. 252 (Fig. 4) presents the same characteristics as the previous example and the three typical circles are slightly visible on the body of the figure. Moreover, a remarkable attention to detail is evident. The peculiar characteristic of visible tool marks on the seal-surface is clearly linked to the talismanic style but, generally, the representation of many details is definitely connected to the naturalistic style.

CMS II, 3 No. 259 (Fig. 5) shows a goat in profile whose body is not schematically represented. In fact, it is not possible to see the typical three circles. The head is stylised through the use of the solid drill and is naturalistically modelled and the posterior legs seem to be slightly modelled too. Finally, the spear disposed on the back of the animal presents a decoration with two circles which obviously is reminiscent of typical cut style decoration.

Dragon

CMS V No. 581 (Fig. 5) shows a dragon. The central and the back part of the figure were made entirely by the use of the wheel in a continuous and curvilinear motion. A different cut created the neck and the head. The use of the wheel for the construction of this figure is different from the usual talismanic technique and the body is modelled. It must be said that the influence of the talismanic style is still considerable in this composition but the figure is closer to the naturalistic style.

Chapter 4 - Appendix 5

Non-talismanic motifs

Human figures (Pl. 41, Figs. 1-4).

CMS XI No. 20a (Fig. 1) shows a chanting priest in profile with long robe holding what could be a papyrus stem. The use of the wheel is evident since it created a series of meticulous details. On the upper part of the body, the wheel was used in a continuous and curvilinear movement for the creation of the head that is interconnected to one arm. The dress appears modelled and is highlighted by lines and semicircles. Finally, both legs and feet are also well modelled. Given that this subject holds something, it follows that we are dealing with a representation of an activity in contrast to the canonical rules of the talismanic style. Since the wheel modelled the entire figure, we cannot consider this representation as talismanic.

CMS III, 2 No. 339 (Fig. 2) shows a similar representation of a human figure in profile. The same method of construction can be clearly seen.

CMS X No. 268 (Fig. 3) shows a mirrored composition representing two human figures with upraised arms holding two griffins on leashes with their backs to the human figures and disposed in a heraldic position. Also in this case, the entire composition is narrative and the fact that figures are highly modelled does not allow us to consider this representation as talismanic.

CMS IS No. 167 (Fig. 4) presents a narrative composition in which two individuals are represented on a talismanic style boat. The human figures were most likely created with two wheels but the engraving process remains unclear. The upper part of their bodies is modelled which is unusual for the talismanic style and for the creation of their clothes, the use of both broad and thin wheels must be assumed judging by their plasticity. Although the boat is represented in the talismanic style, many details were not represented. Thus, this representation can be excluded from the corpus of the talismanic stones.

Chapter 4 - Appendix 6

Mineral characterisation for the case of the talismanic stones

Introduction

Correctly identifying the minerals involved in seal production is one of the biggest challenges in glyptic studies. A classification of the materials is very important because it sheds additional light on the techniques applied to the seals and it allows for reliable data regarding local and imported stones.

Usually, macroscopic and microscopic analyses are used to understand if a seal was made with a hard or a soft material. A macroscopic analysis consists of careful observation of the characteristics of the seal-surface to verify if it is homogenous or if the stone shows a tendency to break. In addition, the colour of the stones can also help to identify the mineral. A microscopic analysis aims for an accurate observation of the tool marks whose morphology depends on a differentiation of engraving techniques. Despite the basic information obtainable from both analyses in terms of hard and soft stones, these traditional methods are often not reliable to reveal a specific mineral characterisation. The introduction of scientific and innovative methods for the study of archaeological materials reveals encouraging results from selected investigations.

The case of the talismanic stones

The mineral characterisation of 99 talismanic stones was dubious for Onassoglou (1985), and still is for ARACHNE, despite that some of these seals have been analysed using two different scientific methods. Ten talismanic seals were analysed through the most common methods, which consist of X-ray fluorescence and SEM-EDS for elemental and stoichiometric analysis as well as for micro-morphological observations, and X-ray diffraction and spectroscopic analyses for molecular/mineralogical identification. Additionally, 40 talismanic seals were analysed using the innovative method of Raman spectroscopy.

Analysis no. 1: the XRF, XRD and SEM-EDS applications and results

The first analysis was carried out on 10 seals housed at the Metropolitan Museum of Art in New York.[4] The identification of the stone type was accomplished by visual observations under the stereomicroscope, XFR and XRD. SEM-EDS analysis was performed on only one seal, CMS XII No. 179. The classifications of CMS XII No. 178, 179, 177 and 220 were not straightforward and they remain problematic. Based on chemistry and mineralogy, the results indicate that these seals are composed of very fine-grained silicate rocks, most likely argillite or shale.

Seal-stones from the Metropolitan Museum of Art (New York)				
Seals		**Motifs**	**Previous identifications**	**Stone identification results**
No. 1	CMS XII No. 260 (UnS No. 20) (26.31.314)	Plants	Onassoglou: steatite ARACHNE: soft stones	Name of the stone: limestone Materials: XRD: calcite XRF: Fe, Si, Al, K, Ca, Mn, Rb, Sr, Zr Mohs' scale hardness: 3-4
No. 2	CMS XII No. 178 (UnS No. 40) (26.31.200)	Octopus	Onassoglou: jasper ARACHNE: jasper green (?)	Name of the stone: argillite/shale (?) Materials: XRD: albite, quartz XRF: Fe, Si, Al, K, Ca, Mn, Rb, Sr, Zr. Mohs' scale hardness: 2-3
No. 3	CMS XII No. 179 (UnS No. 43) (26.31.201)	Crab	Onassoglou: marble ARACHNE: jasper (?)	Name of the stone: argillite/shale (?) Materials: XRF: Fe, Si, Al, K, Ca, Mn, Rb, Sr, Zr.

[4] Open-architecture XRD analysis was performed using Cu Kα radiation between 5° and 60° 2θ, a step size of 0.02° and a scan rate of 1.5° per minute on the whole object. Qualitative, non-destructive, open-architecture X-ray fluorescence analysis was performed with a Bruker Artax instrument using unfiltered Rh radiation at 50 kV, 600 μA, with a 1.5 mm collimator, with 60 seconds live-time acquisition, and in helium atmosphere. SEM-EDS analysis was performed with a FE-SEM Zeiss Σigma HD, equipped with an Oxford Instrument X-Max^{N} 80 SDD detector. Imaging and EDS analysis were realised in low vacuum at 20kV.

				Mohs' scale hardness: 2-3
No. 4	CMS XII No. 177 (UnS No. 45) 26.31.204	Bundles V-shaped	Onassoglou: marble ARACHNE: jasper (?)	Name of the stone: argillite/shale (?) Materials: XRF: Fe, Si, Al, K, Ca, Mn, Rb, Sr, Zr Mohs' scale hardness: 2-3
No. 5	CMS XII No. 220 (UnS No. 52) (26.31.268)	Panel	Onassoglou: marble ARACHNE: jasper black (?)	Name of the Stone: argillite/shale (?) Materials XRF: Fe, Si, Al, K, Ca, Mn, Rb, Sr, Zr Mohs' scale hardness: 2-3
No. 6	CMS XII No. 153 (UnS No. 53) (26.31.190)	Double axe	Onassoglou: steatite ARACHNE: hard stone (?)	Name of the stone: obsidian Materials: XRF: Fe, Ca, K, Si, Al, Mn, Rb, Sr, Zr, Y Mohs' scale hardness: 5-5.5
No. 7	CMS XII No. 279 (UnS No. 67) (26.31.199)	Bird	Onassoglou: conglomerate ARACHNE: hard stone (?)	Name of the stone: snowflake obsidian Materials: XRF: Fe, Ca, Si, Mn, Sr, Y, Zr, Nb Mohs' scale hardness: 5-5.5
No. 8	CMS XII No. 158 (UnS No. 70) (26.31.261)	Fish	Onassoglou: agate ARACHNE: hard stone (?)	Name of the stone: banded jasper Materials: XRF: Si, Fe, K, Al Mohs' scale hardness: 7
No. 9	CMS XII No. 256 (UnS No. 78) (26.31.315)	Fish	Onassoglou: steatite ARACHNE: slate or chlorite	Name of the stone: chlorite schist Materials: XRD: clinochlore XFR: Fe, Si, Mg, Al Mohs' scale hardness: 2-2.5
No. 10	CMS XII No. 280 (UnS No. 79) (26.31.300)	Fish	Onassoglou: steatite ARACHNE: slate or chlorite	Name of the stone: chlorite schist Materials: XFR: Fe, Si, Mg, Al Mohs' scale hardness: 3.5-4

Discussion

Although the identification of the materials for the seals CMS XII Nos. 178 (no. 2), 179 (no. 3), 177 (no. 4) and 220 (no. 5) is still unclear, according to the morphology of the cuts visible on the seals surface, I think these stones are hard. In fact, the tool marks do not seem to correspond to the freehand engraving technique. In other words, all cuts are precise and the lines are straight, meaning that the use of the cutting wheel is involved. Finally, the seal-surfaces are very homogenous.

			
(No. 4) CMS XII No. 177	(No. 2) CMS XII No. 178	(No. 3) CMS XII No. 179	(No. 5) CMS XII No. 220

The rest of the results obtained with this first analysis correspond to what is visible on the seal-surfaces. To sum up, this analysis has clarified the identity of the seals CMS XII Nos. 260 (no. 1), 153 (no. 6), 279 (no. 7), 158 (no. 8), and for 280 (no. 10).

<u>Analysis no. 2: the application of the Raman spectroscopy</u>

The second scientific method applied to the talismanic stones is Raman spectroscopy and it was applied on 40 seals[5] housed at the Archaeological Museum of Heraklion in Crete. Raman spectroscopy is a spectroscopic technique used to observe vibrational, rotational, and other low-frequency modes in a system. This scientific method provides information about the molecule under study, for example the three-dimensional arrangement of the atoms which constitute the molecule. Raman scattering or the Raman effect is the inelastic scattering of a photon upon interaction with matter. The atoms of the molecule vibrate when excited. The scatter bands observed in a Raman spectrum correspond to the vibrations specific for each molecule, chemical compound and mineral in this case.

[5] Among these seals there are seven which have been stylistically revaluated: CMS II, 3 Nos. 94, 132, 355, 356; CMS III Nos. 487 and 489.

The Raman spectroscopic technique has multiple advantages:

- No sample preparation needed.
- Since it is a non-destructive/non-invasive technique, the analysis can be repeated as many times as required.
- It can be applied in situ.

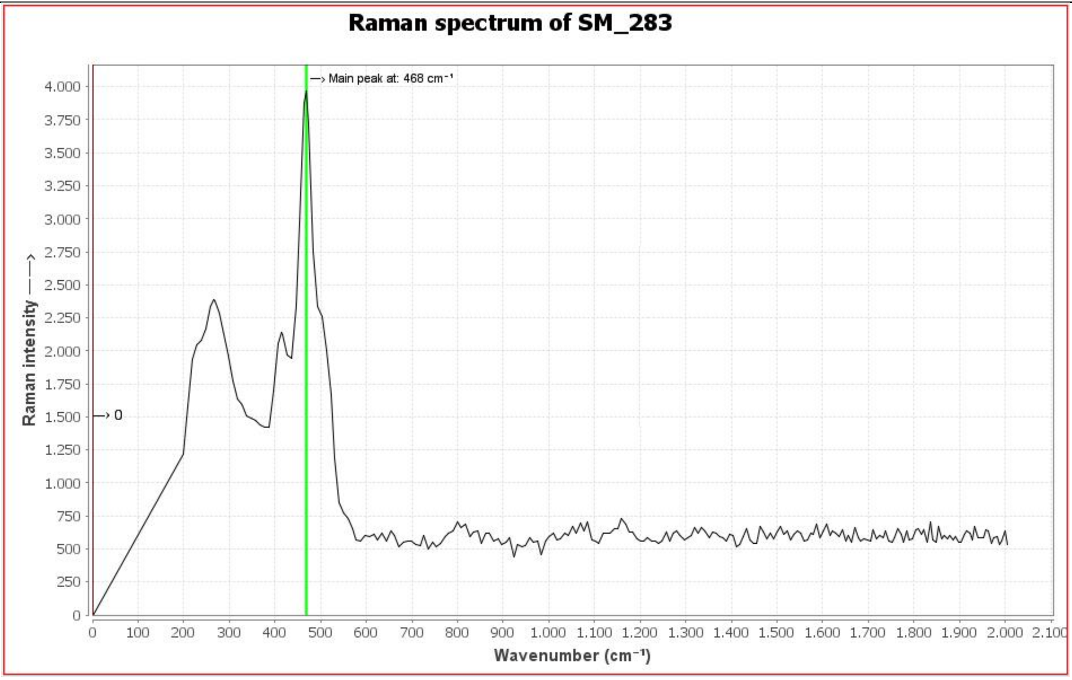
Although this method has many advantages, some disadvantages in some circumstances may be also encountered. For example, this analysis is impracticable in presence of a high fluorescence if there is microcrystalline wax on the surfaces of the stones. In spite of this, the results obtained for this case study on this sample of seal-stones are promising.

We now present and discuss in detail this analysis for each talismanic seal.

No. 1: CMS IV No. 45D (UnS No. 1)

		Onassoglou (1985, p. 208 no. 49): sardonyx ARACHNE: agate (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The sample exhibits strong Raman scattering between 200 and 600 cm^{-1}, which is a typical framework of silicates. The range 3000 – 3600 cm^{-1} generated by the O-H bond stretching modes of the hydrous species incorporated in the silicate matrix could not be recorded due to the limitations of the instrument used (spectral range (200 – 2000 cm^{-1}). The distinctive 460 cm^{-1} band is related to symmetric stretching-bending vibrations of low-α quartz (Götze et al. 1998). Signals at 460 and 490 cm^{-1} are typical of amorphous silica, suggesting that the fraction of non-crystalline material is the dominant phase in this sample.

The Raman spectrum of the external pink-orange layer revealed the presence of opal-CT with the characteristic band at 410 cm^{-1}. Opal-CT is disordered cristobalite with significant tridymite stacking.

Result

Minerals: moganite: crystal system: monoclinic - prismatic (2/m)

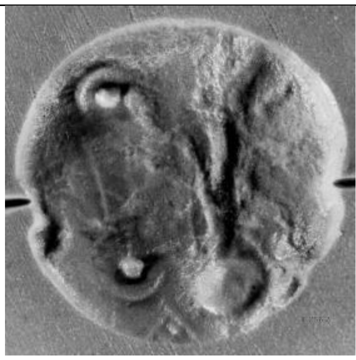
Name of the stone: opal

Mohs' scale hardness: 6.

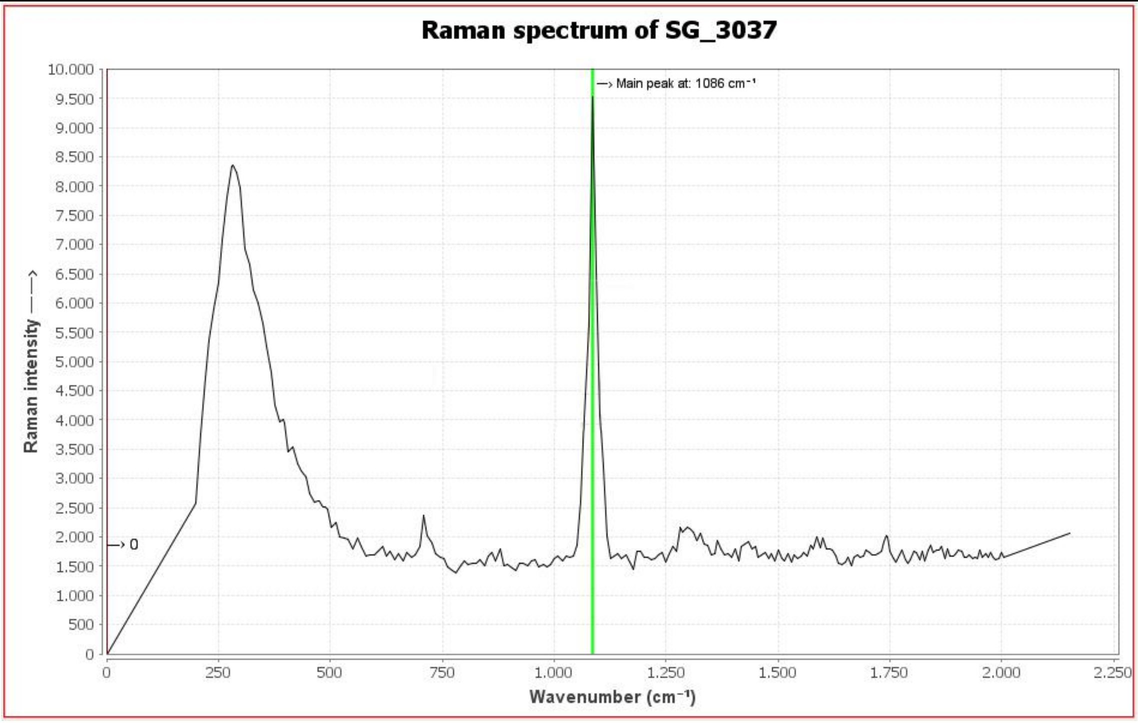
Analysis of the engraving

Technically speaking, it can be confirmed that this stone is hard because the tool marks which compose the amphora motif indicate the use of rotary tools. In fact, the lines are quite straight and they are the same thickness. The same thickness occurs also for the lines which compose the plants disposed on both sides of the figure and on the lines disposed on both sides of the foot of the amphora. These characteristics correspond to the use of the cutting wheel. The usual deep cut, which composes the belly of the figure, was created by a combination of drills which in hard stones are usually very clear.

No. 2: CMS III, 2 No. 256 (UnS No. 4)

		Onassoglou (1980, p. 214 no. 56): jasper ARACHNE: soft stone
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The Raman band at 280 cm^{-1} can refer to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion.

Result

Mineral: limestone

Name of the stone: calcite

Mohs' scale hardness: 3-4

Analysis of the engraving

The motif represented on this seal is a jug and the lines which constitute the neck of the jug are not precise, nor are the inter-connective line which creates the handle of the jug (Fig. 1).

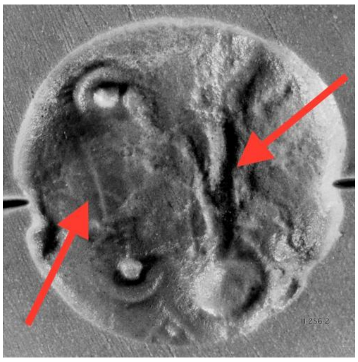


Fig. 1

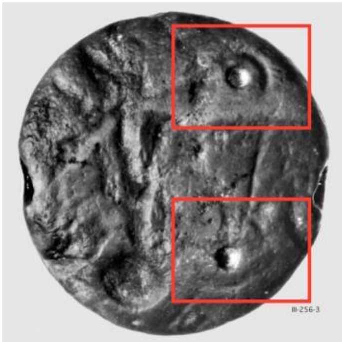


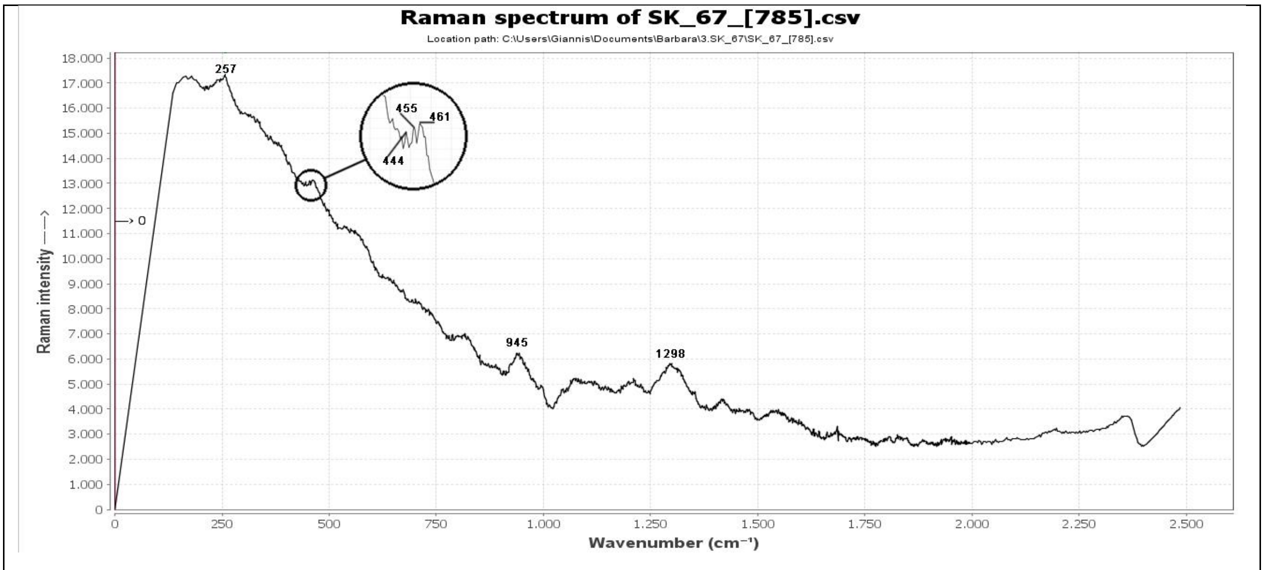
Fig. 2

Moreover, the semicircles created by the tubular drill are not as deep as those seen usually on hard stones (Fig. 2). These imprecisions depend on the softness of the stone but also on the freehand engraving technique. In other words, the technique does not involve fast strokes so that the artisan could not draft precise cuts such as precise straight lines. At the same time, he could not use good drill pressure on the seal-surface. Basically, the softness of the stone affects the technique because it is fragile and easily breakable.

No. 3: CMS II, 3 No. 311 (UnS No. 5)

		Onassoglou 1985, p. 213 no. 44): steatite ARACHNE: agate
Seal	Impression	

Raman spectroscopy analysis



This graph does not show a very resonant Raman spectrum but what can be said is that steatite can be excluded as a potential mineral since none of its characteristic Raman bands can be observed. In fact, the Raman bands observed at the 444 – 461 cm^{-1} region can be attributed to the vibrational mode of α-quartz (trigonal SiO_2). Yet, the Raman band observed at 945 cm^{-1} can be attributed to the v' as vibration of SiO_3 and, therefore, it is indicative of the presence of lawsonite. Moreover, the Raman band observed at 257 cm^{-1} can be attributed to the glaucophane but this is just an indication since the dominant and characteristic band of this mineral at 671 cm^{-1} is not present in the spectra acquired from this item. Finally, the Raman band observed at 1300 cm^{-1} is indicative of the presence of organic material.

<u>Result</u>

Mineral: lawsonite

Name of the stone: blueschist

Mohs' scale hardness: 7.5

<u>Analysis of the engraving</u>

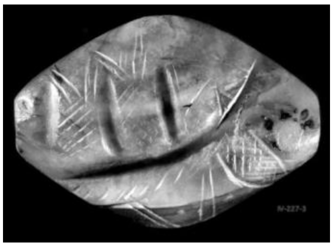
The cuts which compose the jug motif are characterised by precise straight lines or slightly curved lines. In addition, a perfect and clear combination of overlapped drills for the creation of the belly can be noted (Fig. 1), as well as the semicircles which constitute the upper part of the handle of the figure (Fig. 2).

Fig. 1

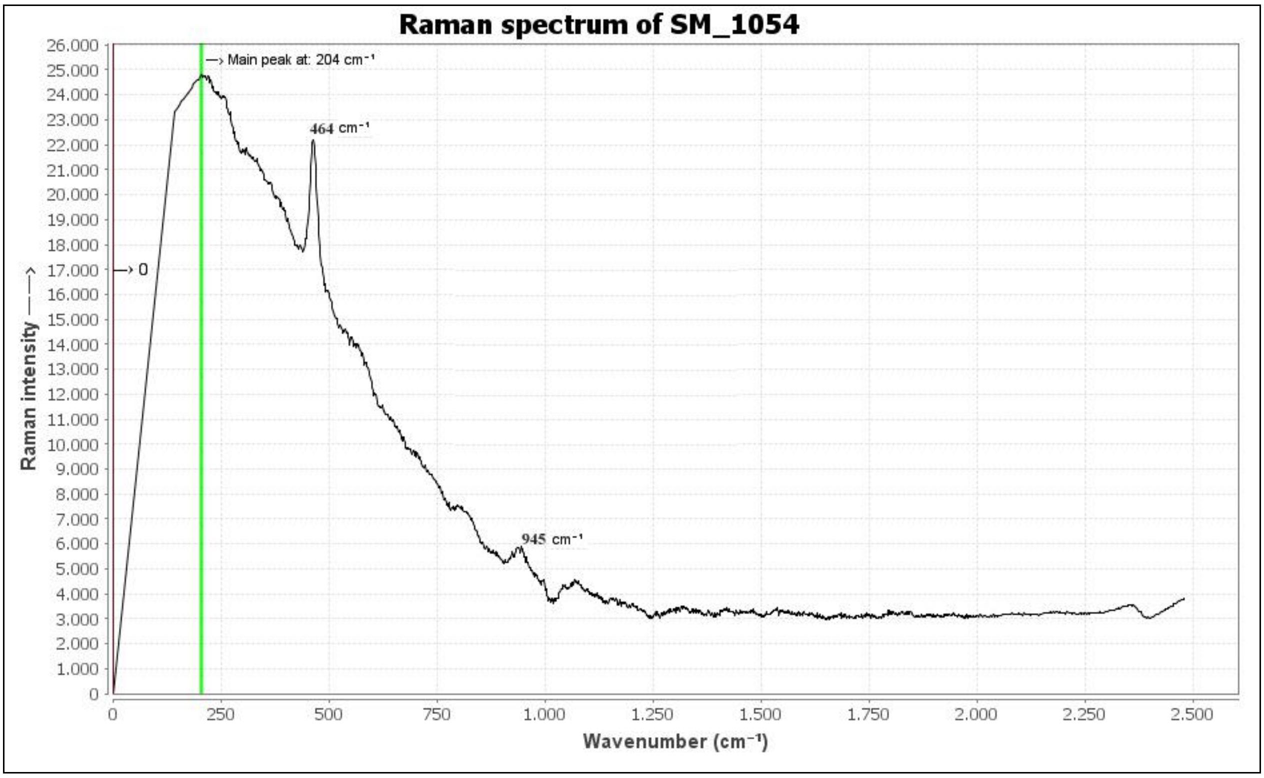
Fig. 2

This clarity for each cut depends on the very fast movement given by the speed of the mechanical equipment allowing the artisan to make very fast strokes.

No. 4: CMS IV No. 227 (UnS No. 9)

		Onassoglou (1985, p. 220 no. 8): sardonyx ARACHNE: agate (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



In all the spectra acquired from this seal, α-quartz (SiO_2) is the dominant mineral. In fact, the distinctive symmetric stretching-bending vibrations (A1 modes) of α-quartz (465 and 205 cm^{-1}) are observed. Signals at 460 and 490 cm^{-1} are typical of amorphous silica suggesting that the fraction of non-crystalline material is the dominant phase in this example.

Sard is a translucent, brown chalcedony and it should not be banded or striated, but very often it is just a brown portion cut out of a large agate. Only the tone of the colour allows one to distinguish carnelian from sard since the latter is browner. Both agate and carnelian are types of chalcedony but in terms of hardness on the Mohs' scale, they present a range between 6-7. In this case, one Raman band at 940 cm^{-1} could be attributed to lawsonite but there is no adequate data to support this assumption.

Result

Mineral: quartz

Name of the stones: agate

Mohs' scale hardness: 7

Analysis of the engraving

The cuts which compose this figure confirm that this stone is hard because the use of rotary tools emerges clearly. For example, the cut which makes the hull is typical of a broad cutting wheel (Fig. 1).

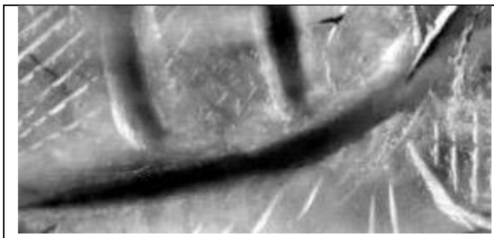


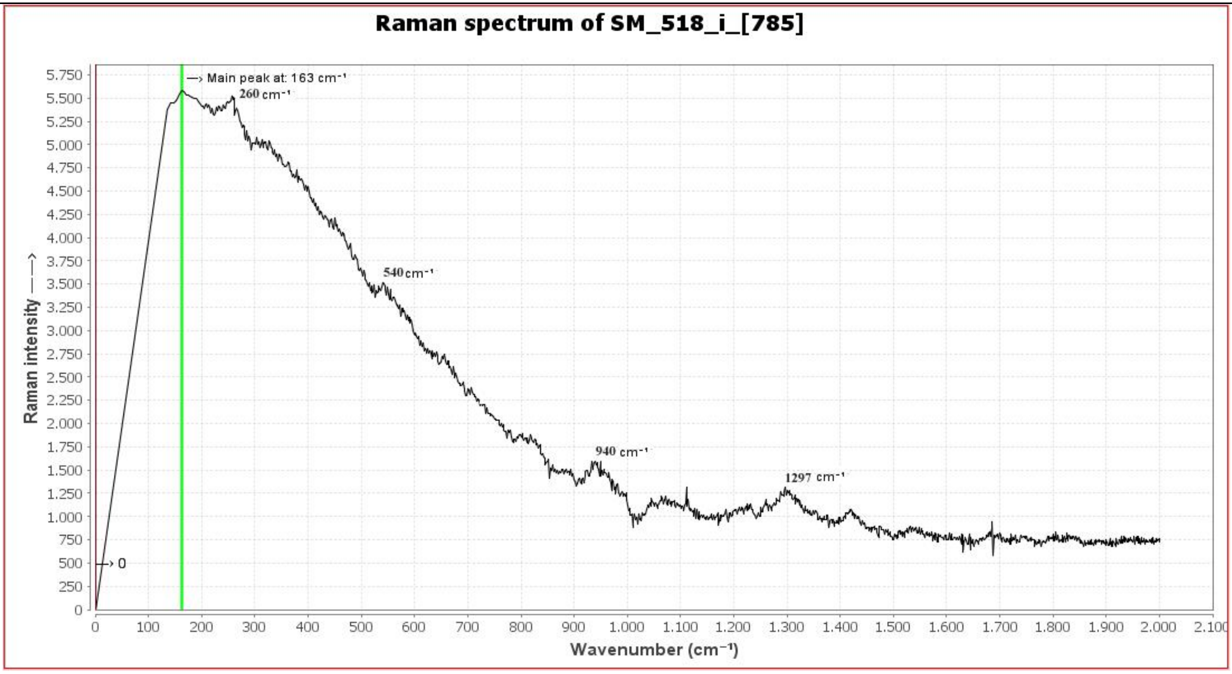
Fig. 1	Fig. 2

Moreover, the cross-hatching visible between the masts is composed of very straight lines characterised by the same thickness (Fig. 2) which is indicative of the use of a thin cutting wheel. These marks are difficult to create freehand in a soft stone.

No. 5: CMS IV No. 50D (UnS No. 11)

		Onassoglou (1985 p. 224 no. 24): serpentine ARACHNE: serpentine or slate
Seal	Impression	

<u>Raman spectroscopy analysis</u>



In this case, no bands from the serpentine family of minerals are present (characteristic Raman band for chrysotile/lizardite: 690 – 692 cm^{-1}, antigorite: 683 cm^{-1}).

<u>Result</u>

Not clear

<u>Analysis of the engraving</u>

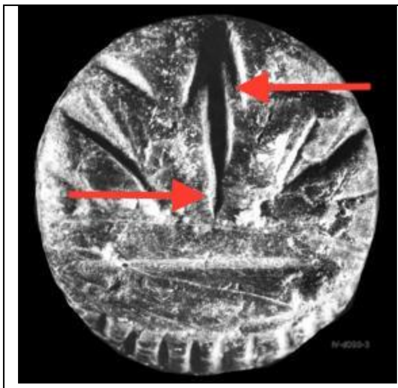


Fig. 1	Fig. 2

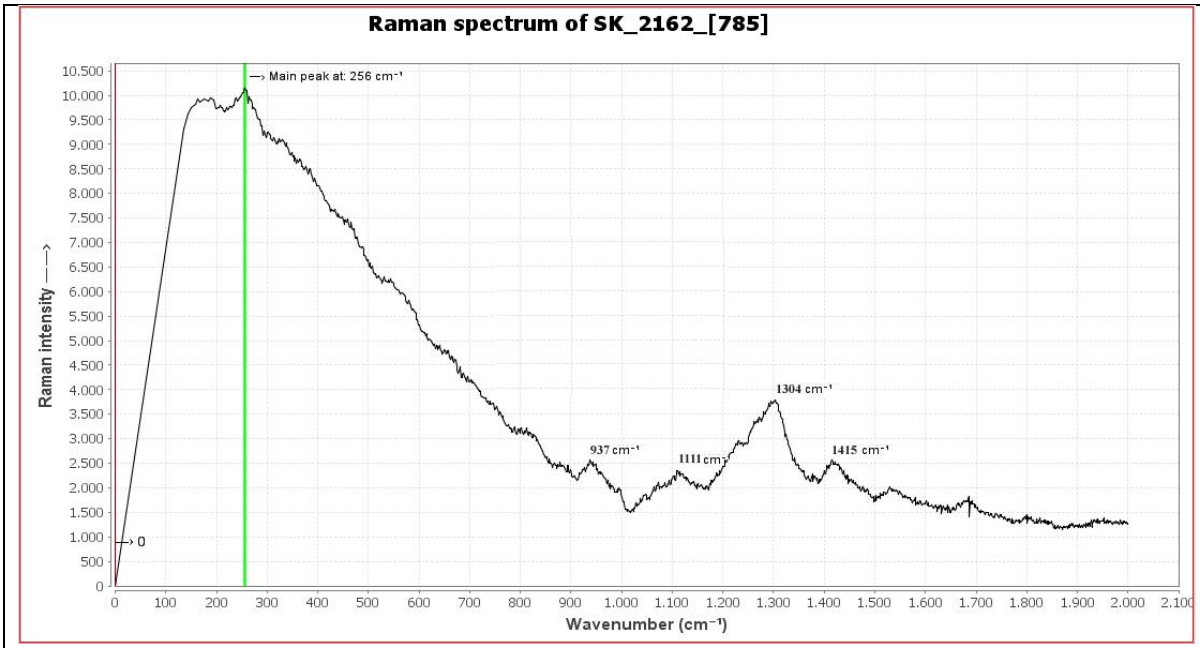
Looking carefully at the cuts, this figure is composed of a series of little straight cuts but if we look at the central cut (Fig. 1), it does not seem to be very precise and this depends on the pressure of the tools during the engraving process. In fact, the tool could not be the cutting wheel but most likely a simple knife. Yet, on the left side of the impression, it is possible to see several indistinct lines (Fig. 2) which were clearly created by a knife (Fig. 1). This evidence indicates that this stone is soft and the use of freehand engraving technique may be assumed.

No. 6: CMS II, 2 No. 16 (UnS No. 14)

<table>
<tr><td></td><td></td><td rowspan="2">Onassoglou (1985, p. 223 no. 14): steatite

ARACHNE: slate or serpentine</td></tr>
<tr><td>Seal</td><td>Impression</td></tr>
</table>

Raman spectroscopy analysis



This graph shows the absence of bands belonging to the serpentine family of minerals (characteristic Raman band for chrysotile/lizardite: 690 – 692 cm^{-1}, Antigorite: 683 cm^{-1}) and from steatite (676 cm^{-1}).

Result

Not clear

Analysis of the engraving

The observation of the cuts of this figure clearly suggests that the three central lines (Fig. 1) seem to have been engraved by a cutting wheel. Furthermore, the marks left by the drills are quite clear (Fig. 2) but not as clear as those usually visible in hard stones. In fact, the thinner lines engraved on this seal seem representative of the freehand technique since they are not so straight. Thus, these attestations may indicate that this stone is a soft stone.

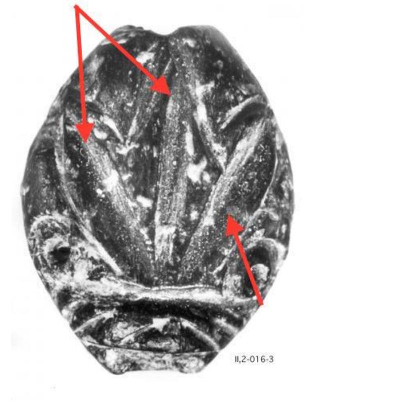
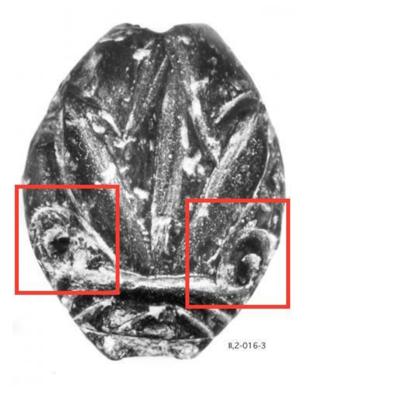
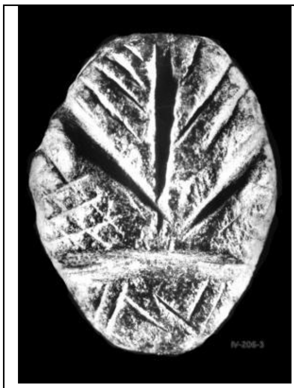
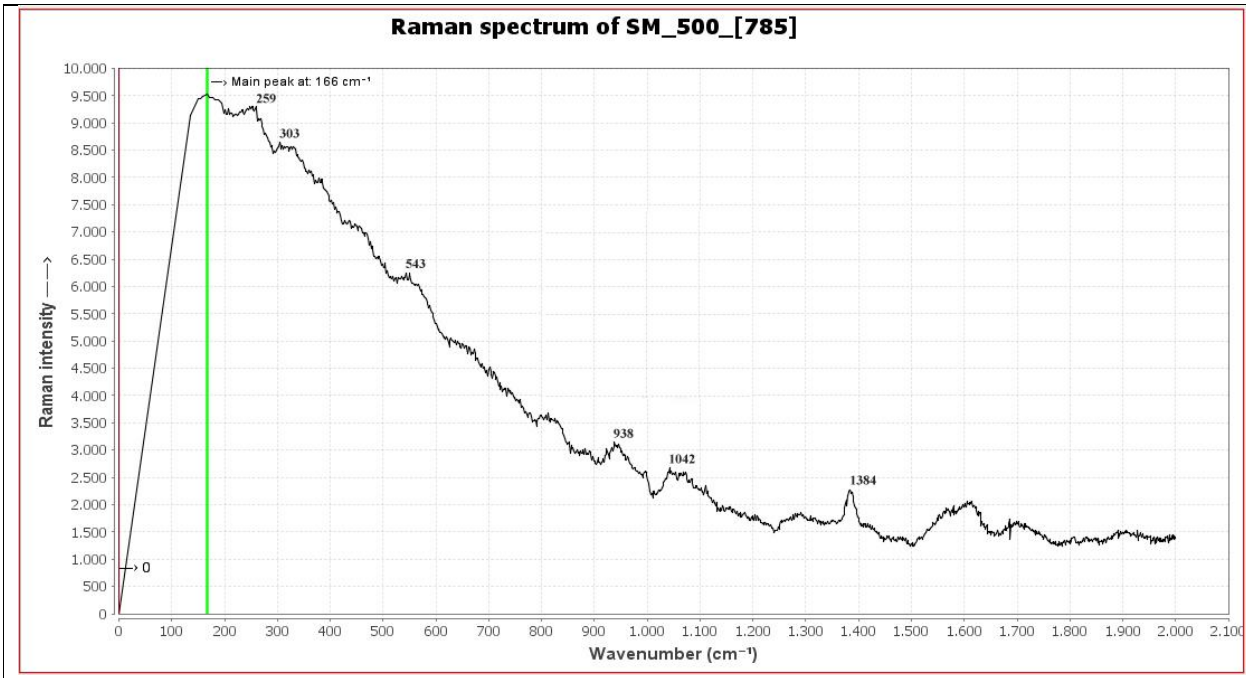
	

Fig. 1	Fig. 2

No. 7: CMS IV No. 206 (UnS No. 15)

		Onassoglou (1985, p. 223 no. 17): marble ARACHNE: steatite or serpentine
Seal	Impression	

Raman spectroscopy analysis



Again, in this case there are no bands from the serpentine family of minerals (characteristic Raman band for chrysotile/lizardite: 690 – 692 cm^{-1}, Antigorite: 683 cm^{-1}), nor from calcite (1087 cm^{-1}).

Result

Not clear

Analysis of the engraving

Although the three central cuts are different, the straight cut disposed on the left side of the seal-surface (Fig. 1) would seem engraved by a cutting wheel because parallel lines can be seen and, in addition, this seems to be one precise stroke made by a cutting wheel. More microscopic analysis is required to be able to comprehend the nature of this stone.

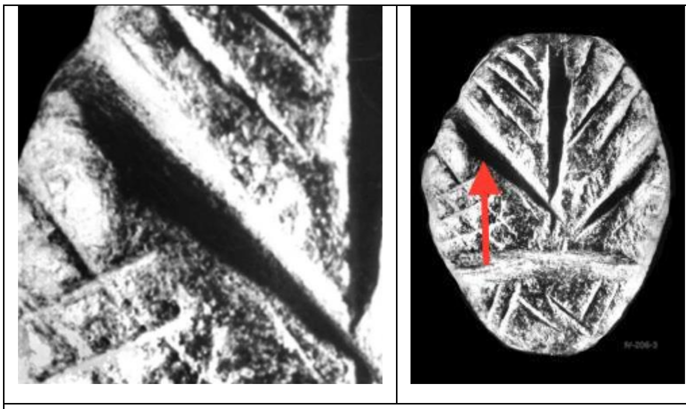
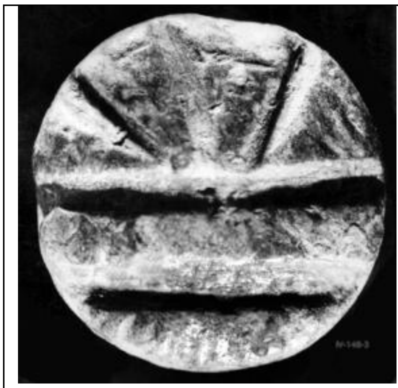
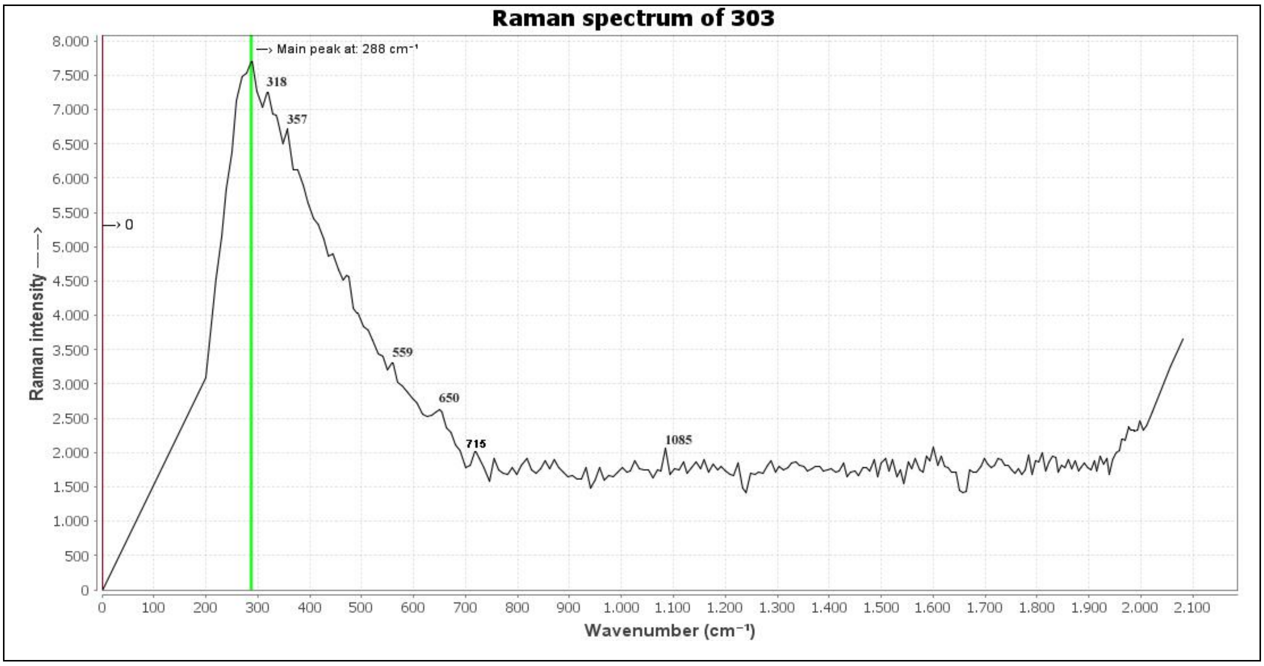


Fig. 1

No. 8: CMS IV No. 148 (UnS No. 17)

		Onassoglou (1985, p. 227, A): marble ARACHNE: serpentine (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



Despite the poor quality of this spectrum, one of the minerals present is calcite ($CaCO_3$). In fact, the Raman band at 280 cm^{-1} can be referred to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The Raman band is at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion. The bands present at 318, 357, 445, 472 and 650 cm^{-1} can be attributed to the presence of the serpentine family of minerals. In this case there was a low intensity and the bands are slightly shifted. Thus, if it is a mineral from the serpentine family, then this rock could be characterised as ophicalcite. Regarding the Mohs' scale hardness, serpentine minerals are within the 2.5-3 range and calcite has a hardness of 3. Therefore, we could categorise the raw material of this item as a rather soft rock.

<u>Result</u>

Mineral: calcite and serpentine (?)

Name of the stone: ophicalcite

Mohs' scale hardness: 3-4

<u>Analysis of the engraving</u>

In this case the cuts are not precise and the three lines disposed on the upper part of the seal do not show a homogenous surface (Fig. 1). This characteristic is not usually visible on the seals in hard stones and, for this reason, we are dealing with a soft material.

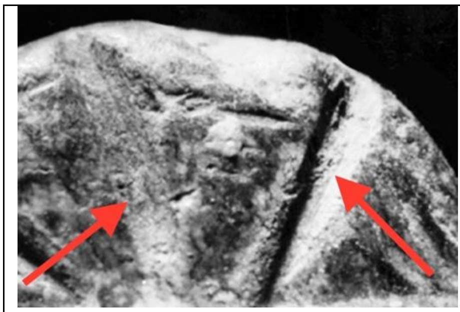
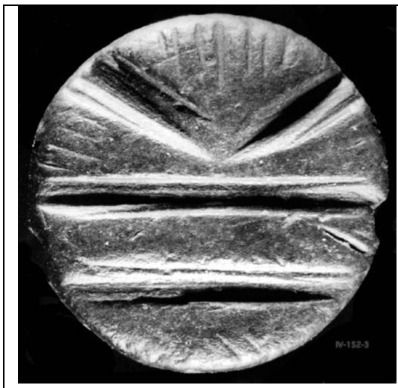
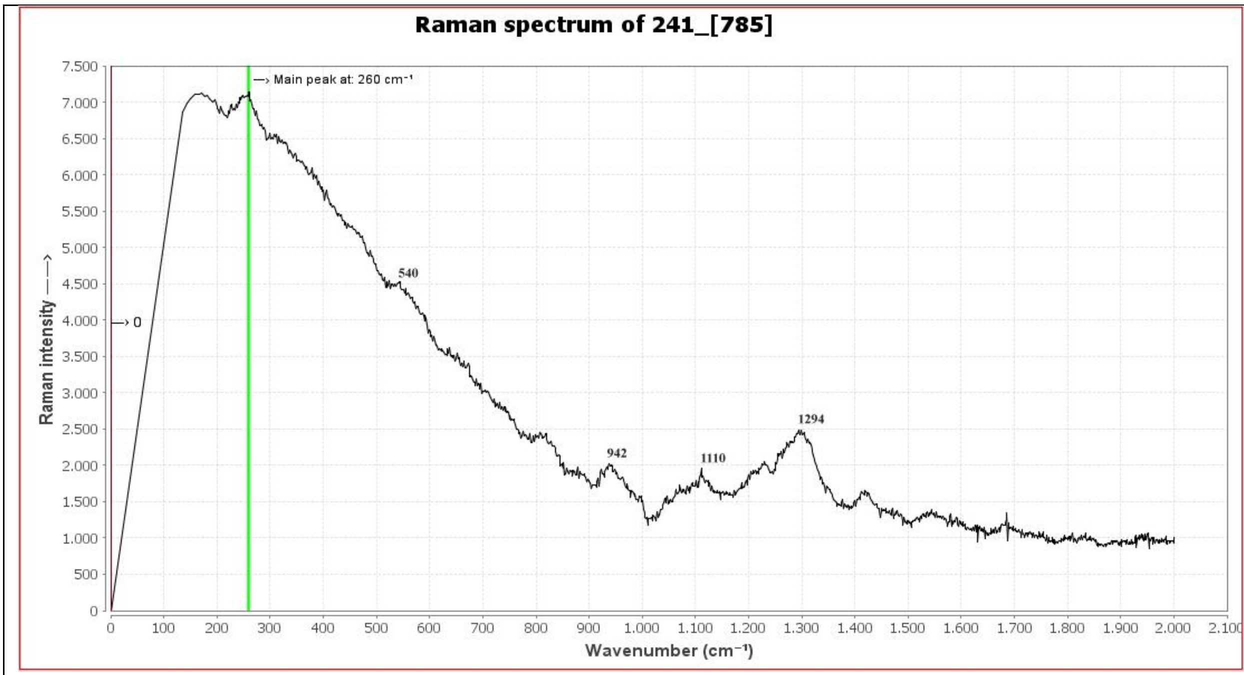


Fig. 1 detail

No. 9: CMS IV No. 152 (UnS No. 18)

		Onassoglou: marble ARACHNE: steatite or serpentine
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The Raman band at 940 cm^{-1} seems to be attributed to lawsonite but there is no adequate data to support this assumption.

<u>Result</u>

Mineral: lawsonite

Name of the stones: blueschist

Mohs' scale hardness: 7-7.5

Analysis of the engraving

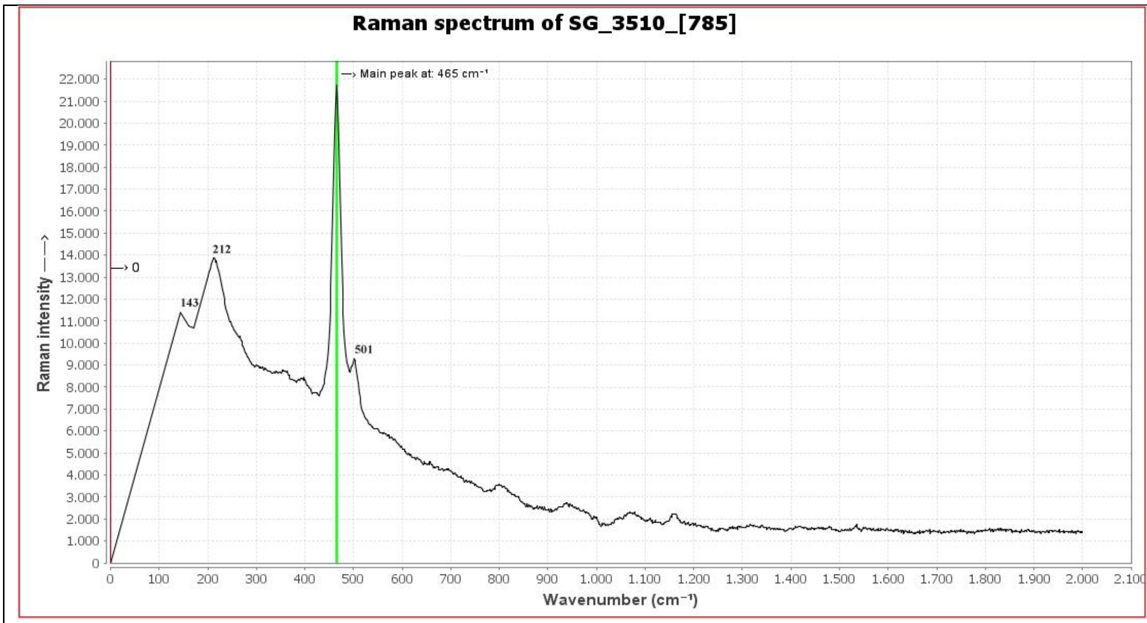
Fig. 1

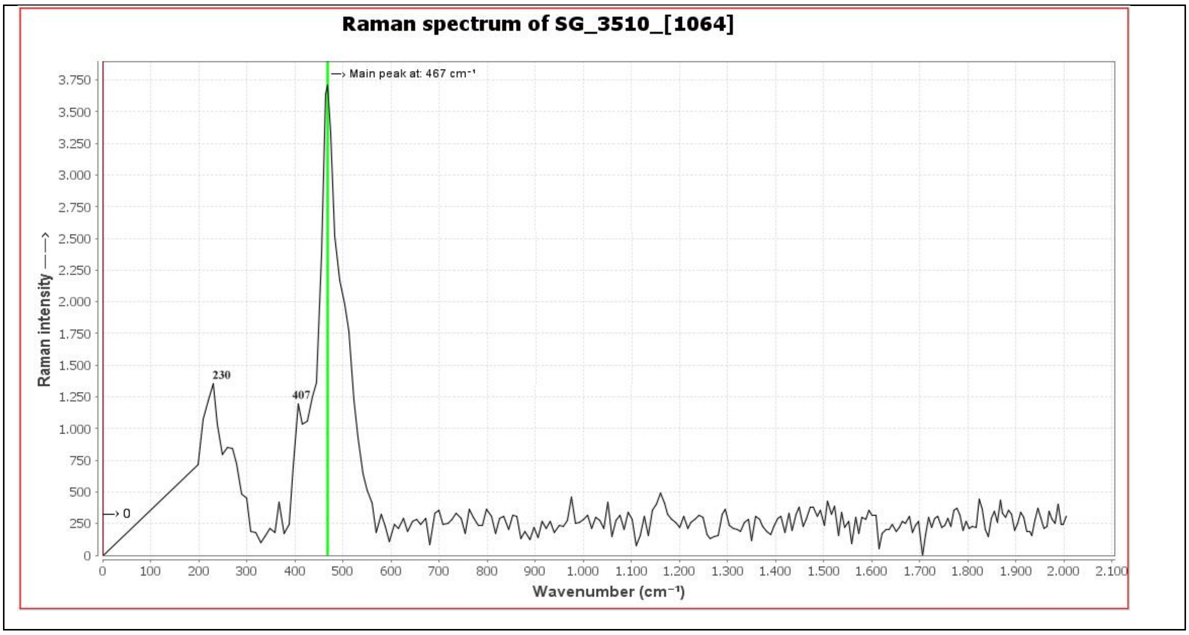
From a technical point of view, the cuts disposed on the upper part of the seal are very deep and the surface visible in the cuts is very smooth. Clearly, they must have been made by a cutting wheel (Fig. 1), meaning that we are dealing with a hard stone.

No. 10: CMS III No. 267 (UnS No. 21)

		Onassoglou (1985, p. 223 no. 11): chalcedony ARACHNE: hard stones
Seal	Impression	

Raman spectroscopy analysis





This graph illustrates a strong Raman scattering between 200 and 600 cm^{-1} which is typical of framework silicates. The distinctive 460 band is related to symmetric stretching-bending vibrations of low-α quartz. Yet, signals at 460 and 490 cm^{-1} are typical of amorphous silica, suggesting that the fraction of non-crystalline material is the dominant phase in this sample.

The most intense bands for quartz (460 cm^{-1}), opal (412 cm^{-1}) and moganite (501 cm^{-1}) were identified in each point of the analytical grid. The Raman spectrum of the external pink-orange layer revealed the presence of opal-CT with the characteristic band at 410 cm^{-1}. Opal-CT is disordered cristobalite with significant tridymite stacking. The Raman spectrum of the external pink-orange layer revealed the presence of opal-CT with the characteristic band at 410 cm^{-1} (Pop et al. 2004). Hematite in the agate matrix is evidenced by marker bands at 292, 410, and 610 cm^{-1} and these bands are attributed to symmetric bending vibrations of Fe-O.

<u>Result</u>

Mineral: quartz

Name of the stone: agate

Mohs' scale hardness: 7

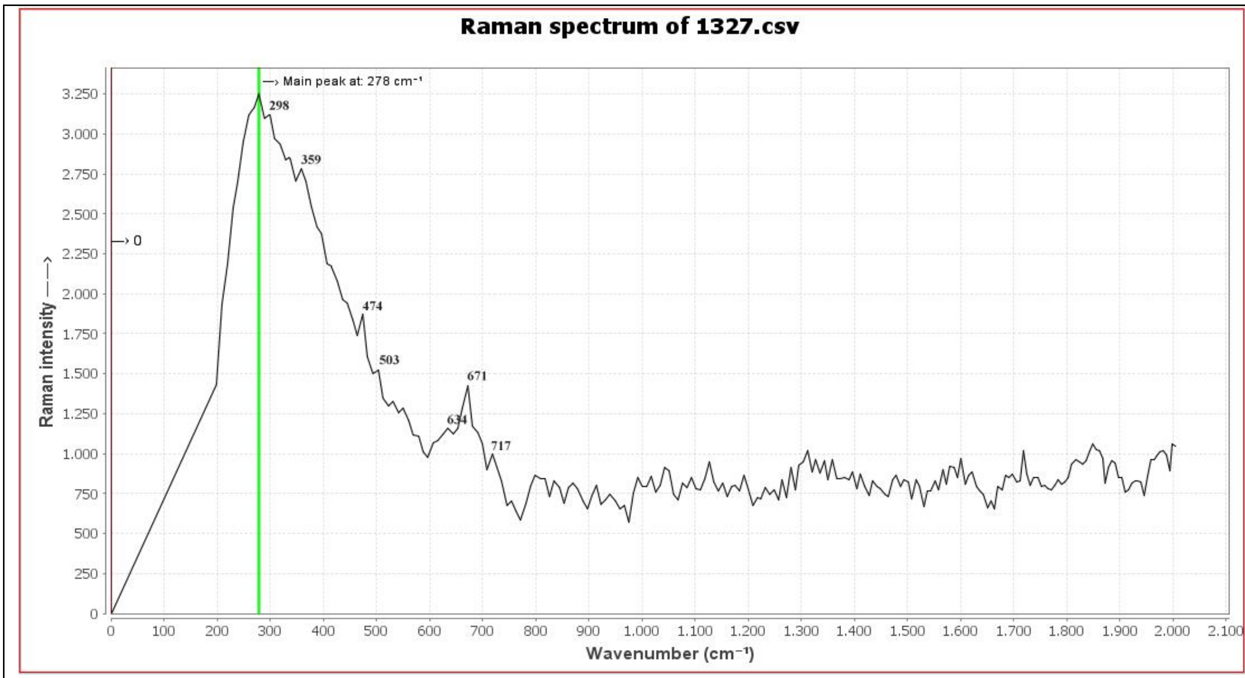
Analysis of the engraving

The cuts visible on the seal indicate that this stone is hard. In fact, these cuts are clearly made by the use of the broad cutting wheel which created precise, deep cuts. It can also be noted that the seal-surface appears very smooth which is a characteristic of hard stones. These attestations confirm that this stone is hard and that the engraving process was mechanical.

No. 11: CMS II, 3 No. 37 (UnS No. 24)

		Onassoglou (1985, p. 222 no. 6): serpentine ARACHNE: steatite or serpentine
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The graph shows an indication of steatite ($Mg_3Si_4O_{10}(OH)_2$: SiO2: 60.06%, MgO: 30.83%) at 297, 360, 470 and 671 cm^{-1} which is the dominant Raman band for this mineral. In talc-rich schists or steatite through hydrothermal alteration of ma¯c rocks (steatitisation) subsequent to serpentinisation during greenschist facies metamorphism. It is also formed by thermal low-temperature metamorphism of siliceous dolostones. Mohs' scale hardness: 1 (defining mineral).

The bands at 279 cm^{-1} are indicative of brucite ($Mg(OH)_2$) which is one of the two component minerals of serpentines with the other being quartz (SiO_2). Mohs' scale hardness: 2.5 to 3.

Result

Mineral: olivine, basalt and andesite

Name of the stones: steatite

Mohs' scale hardness: 1

Analysis of the engraving

According to the cuts visible on the seal-surface, the two upper oblique lines are not engraved with the usual single stroke but different overlapped lines can be seen (Fig. 1), similar to the base line (Fig. 2). The cross-hatching disposed under the base line was engraved freehand because the lines are not straight as usually seen for the creation of cross-hatching on hard stones.

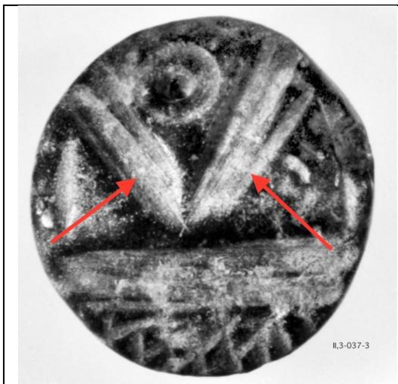
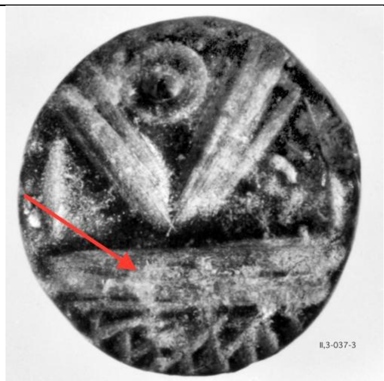
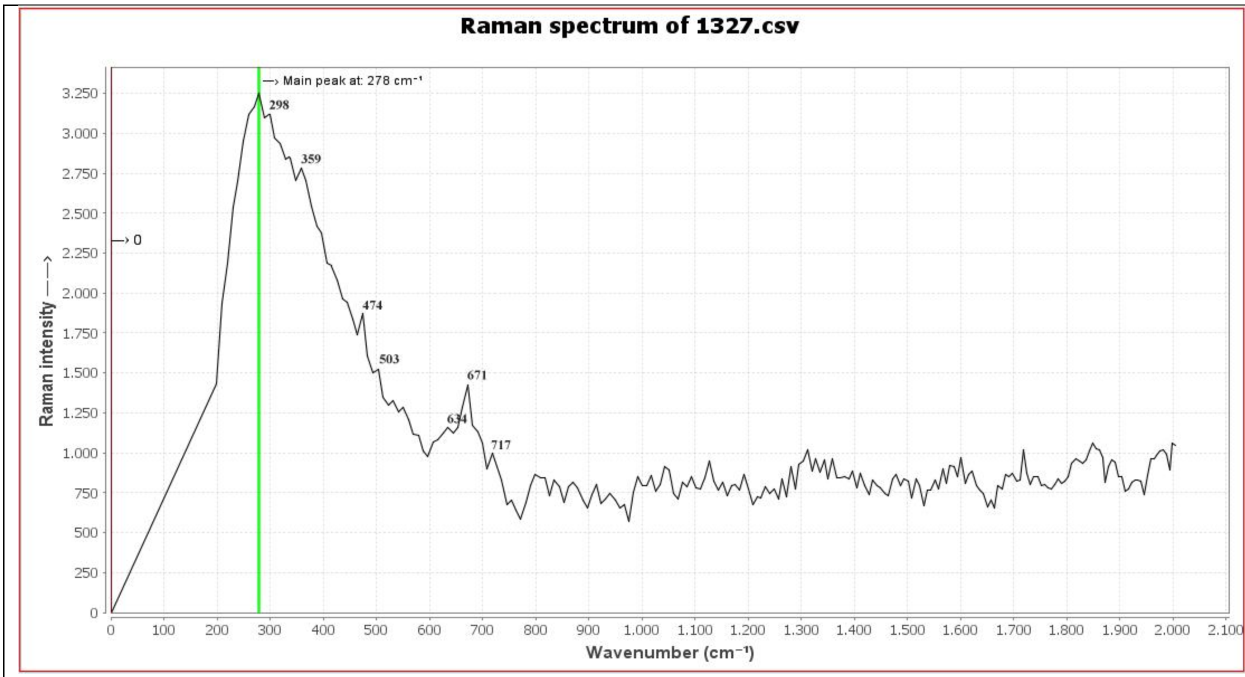
	

Fig. 1	Fig. 2

No. 12: CMS II, 3 No. 144 (UnS No. 25)

		Onassoglou (1985, p. 224 no. 19): serpentine ARACHNE: serpentine or steatite
Seal	Impression	

Raman spectroscopy analysis



The graph shows an indication of steatite ($Mg_3Si_4O_{10}(OH)_2$: SiO2: 60.06%, MgO: 30.83%) at 297, 360, 470 and 671 cm^{-1}, which is the dominant Raman band for this mineral. In talc-rich schists or steatite through hydrothermal alteration of ma¯c rocks (steatitisation) subsequent to serpentinisation during greenschist facies metamorphism. It is also formed by thermal low-temperature metamorphism of siliceous dolostones. Mohs' scale hardness: 1 (defining mineral).

The band at 279 cm^{-1} is indicative of brucite ($Mg(OH)_2$), which is one of the two component minerals of serpentines with the other being quartz (SiO_2).

Result

Minerals: chrysotile/lizardite

Name of the stone: serpentine

Mohs' scale hardness: 2.5 to 3

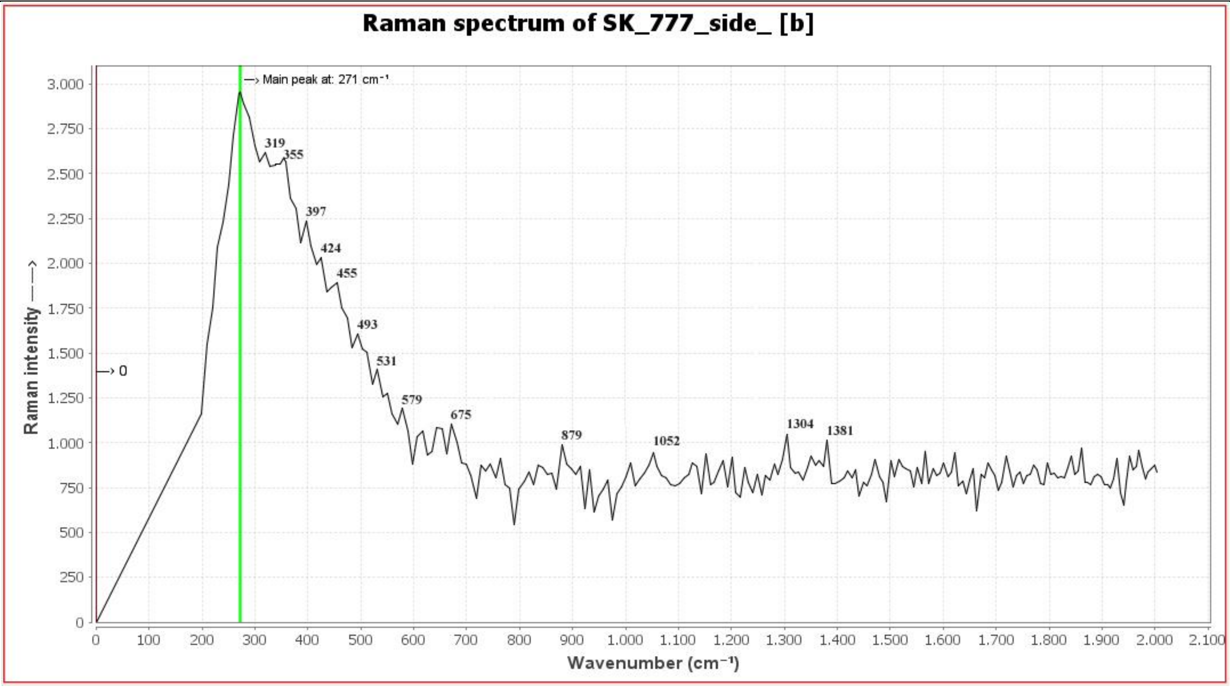
Analysis of the engraving

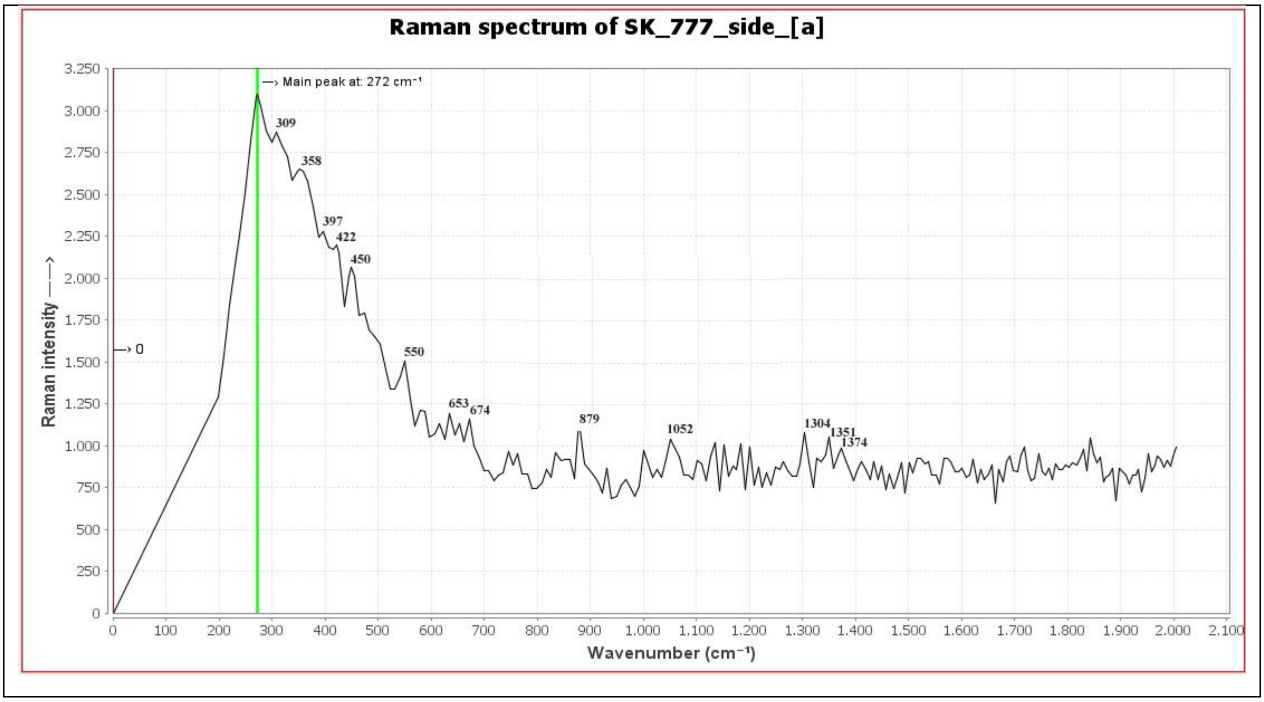
The observation of the cuts clearly indicates that this is a soft stone engraved freehand. In fact, the central cut is not straight and this depends on the use of a simple knife. Moreover, the cuts present dissimilar thickness.

No. 13: CMS II 3 No. 255 (UnS No. 26)

		Onassoglou (1985, p. 224 no. 20): steatite ARACHNE: soft stone
Seal	Impression	

<u>Raman spectroscopy analysis</u>





The Raman bands at: 358, 450, 674, 1052 and 1381 cm^{-1} indicate the presence of steatite (talc). Yet, the Raman band at 674 cm^{-1} corresponds to the symmetric Si-O-Si bending vibration which is characteristic for this mineral.

Result

Minerals: brucite/silicone

Name of stone: steatite

Mohs' scale hardness: 1

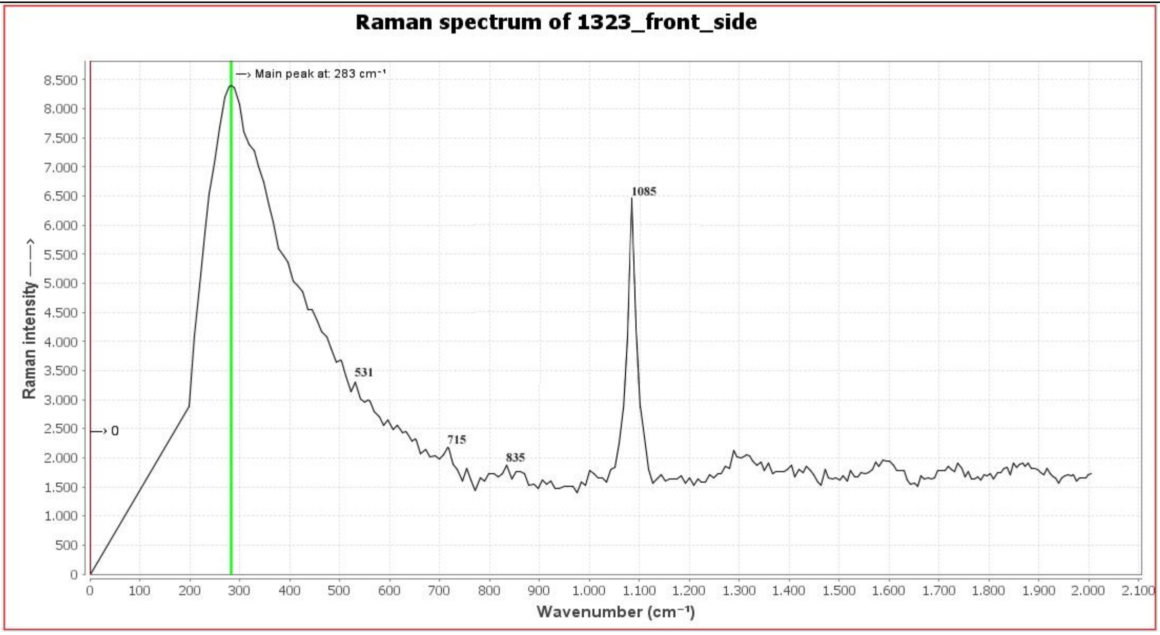
Analysis of the engraving

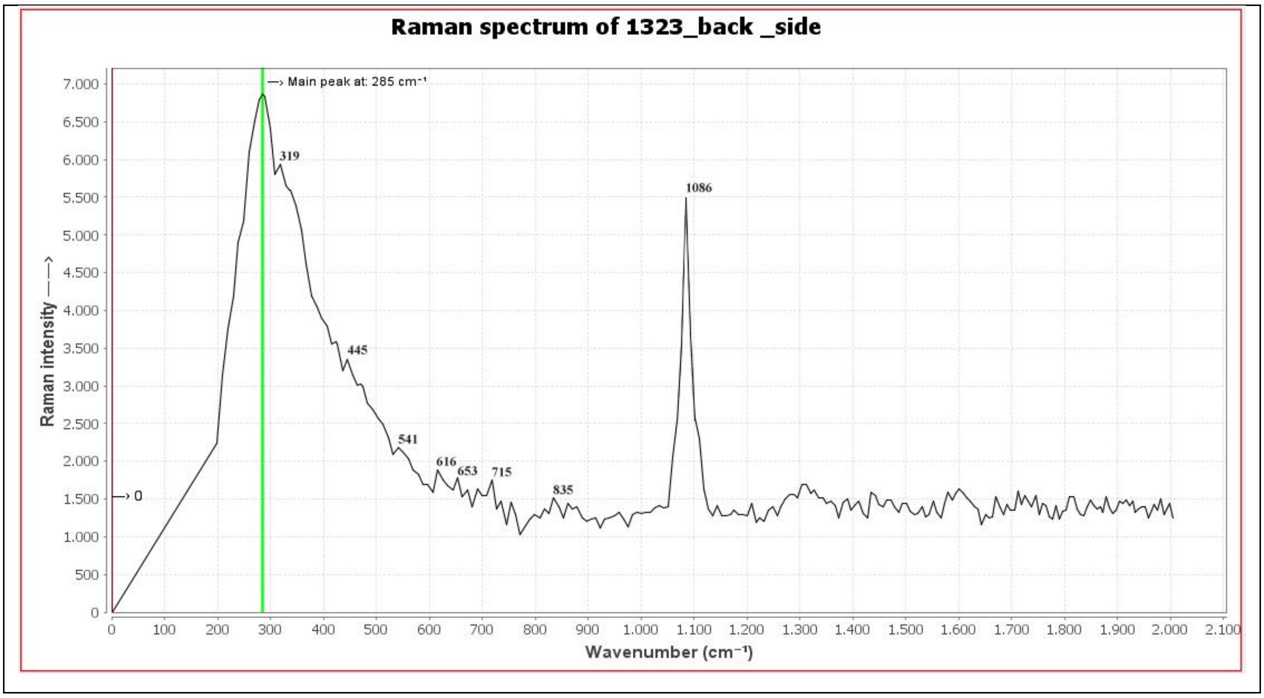
At the first glance, the cuts cannot be distinguished and this is due to the softness of the stone which is fragile and breakable.

No. 14: CMS II, 3 No. 29 (UnS No. 30)

		Onassoglou (1985, 233 no. 16): Jasper ARACHNE: soft stone
Seal	Impression	

<u>Raman spectroscopy analysis</u>





For this stone, the dominant mineralogical phase is calcite ($CaCO_3$). The Raman band at 280 cm^{-1} refers to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion.

Based on the data obtained from this seal-stone, there is no indication of jasper. The spectrum on the background, used as a reference for jasper, is acquired from sample of jasper from the Museum of Natural History of Crete and it originated from the Gonies Maleviziou area.

Result

Mineral: calcite

Name of the stone: banded limestone

Mohs' scale hardness: 3-4

Analysis of the engraving

The surface of this seal does not seem clear. Some tool marks such as the central line which creates one of the tentacles (Figs. 1-2) indicates that we are dealing with a soft stone because we cannot see the usual parallel lines visible in the examples of the hard stones typically made by the cutting wheel.

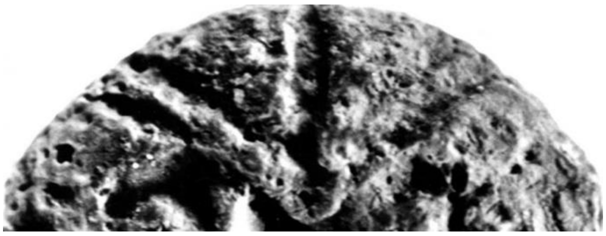
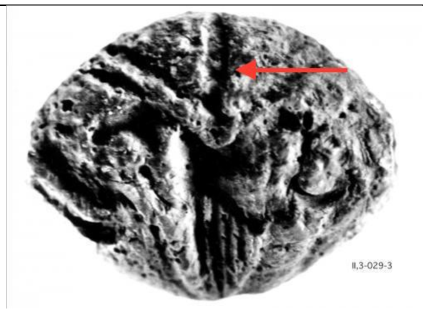
	

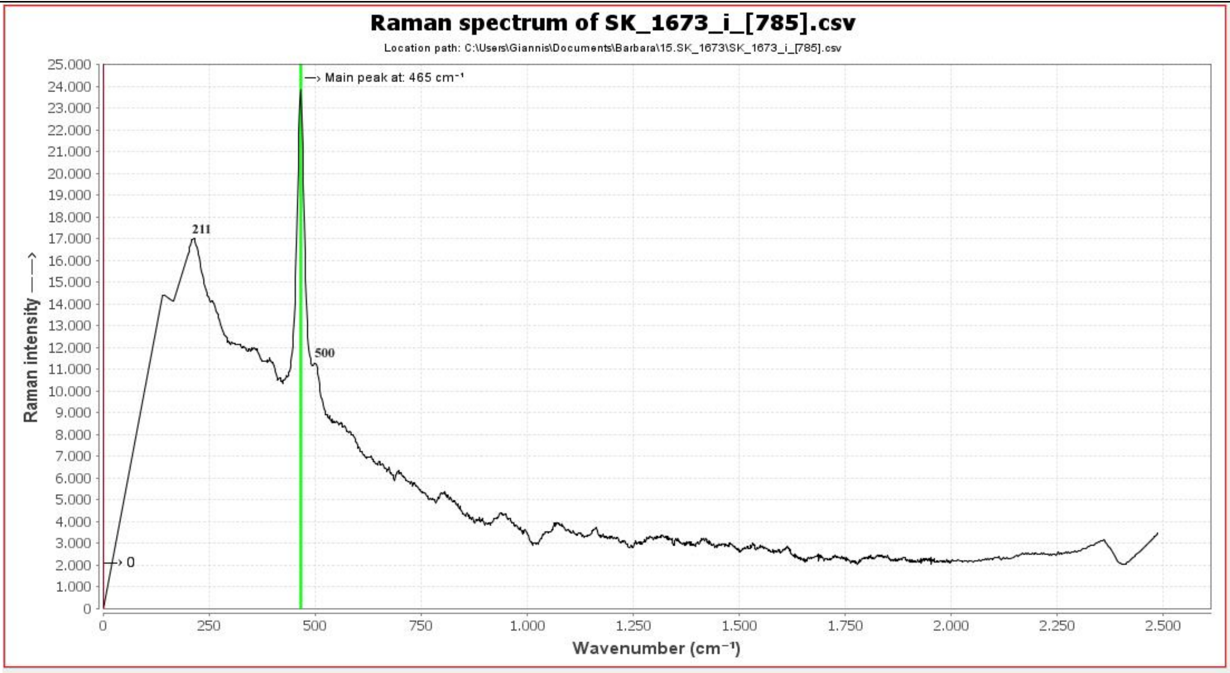
Fig. 1	Fig. 2

In fact, the surface visible on the tool marks is not homogeneous which means that the tool broke the surface due to the stone’s softness.

No. 15: CMS II, 3 No. 229 (UnS No. 32)

		Onassoglou (1985,. 232, no. 12): steatite ARACHNE: jasper (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The distinctive peak or the so called "shoulder" of the 465 cm^{-1} quartz band, which is noticeable at values around 500 cm^{-1}, was interpreted as evidence for the presence of moganite intergrown with α- quartz. Mohs' scale hardness: 6.

The distinctive symmetric stretching-bending vibrations (A1 modes) of α-quartz (465 cm^{-1}) and moganite (502 cm^{-1}) can be seen. Signals at 460 and 490 cm^{-1} are typical of amorphous silica, which suggests that the fraction of non-crystalline material is the dominant phase in this sample. Although the 460 cm^{-1} band is dominant, it suggests that the ratio of moganite/α-quartz is approximately a mixture of 50 wt% moganite and 50 wt% quartz(2).

Result

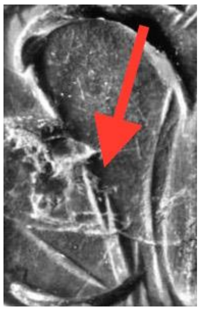
Minerals: moganite/α-quartz

Name of the stone: chalcedony

Mohs' scale hardness: 6

Analysis of the engraving

In this case, the use of the cutting wheel is clear. For example, it can be seen in the usual central line made by one stroke of the broad cutting wheel (Fig. 1).

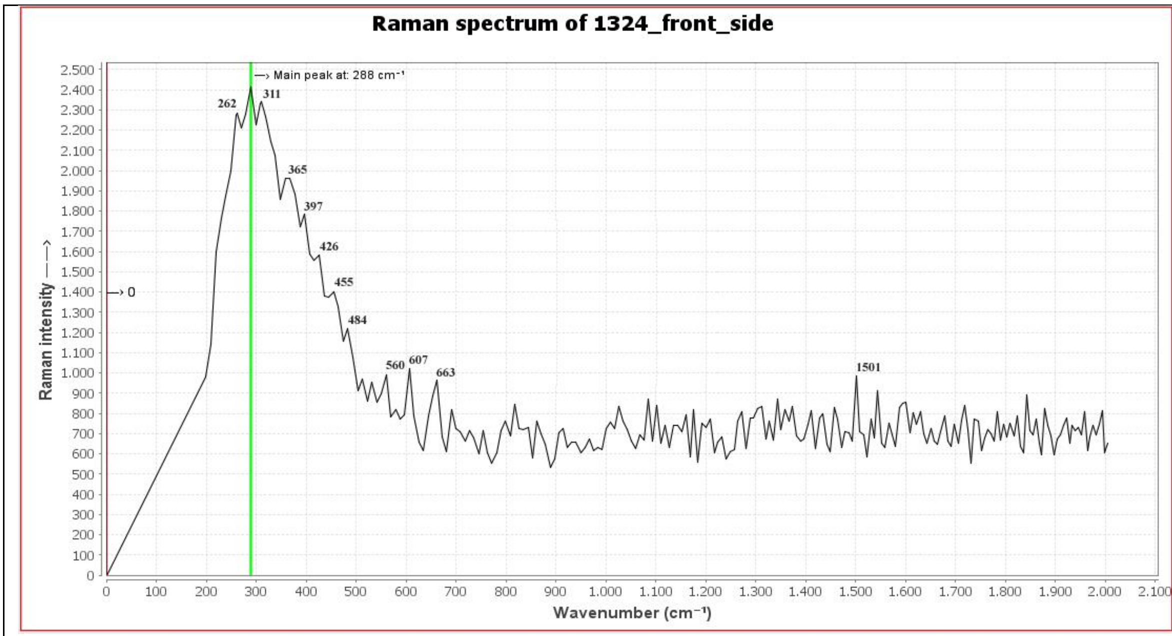
	
Fig. 1	Fig. 2

The interconnective line visible for the S-shaped cut disposed on the left side of the seal-surface was also created by the cutting wheel as the little straight lines demonstrate (Fig. 2). Finally, the surface is clearly homogeneous and this confirms that this is a hard stone.

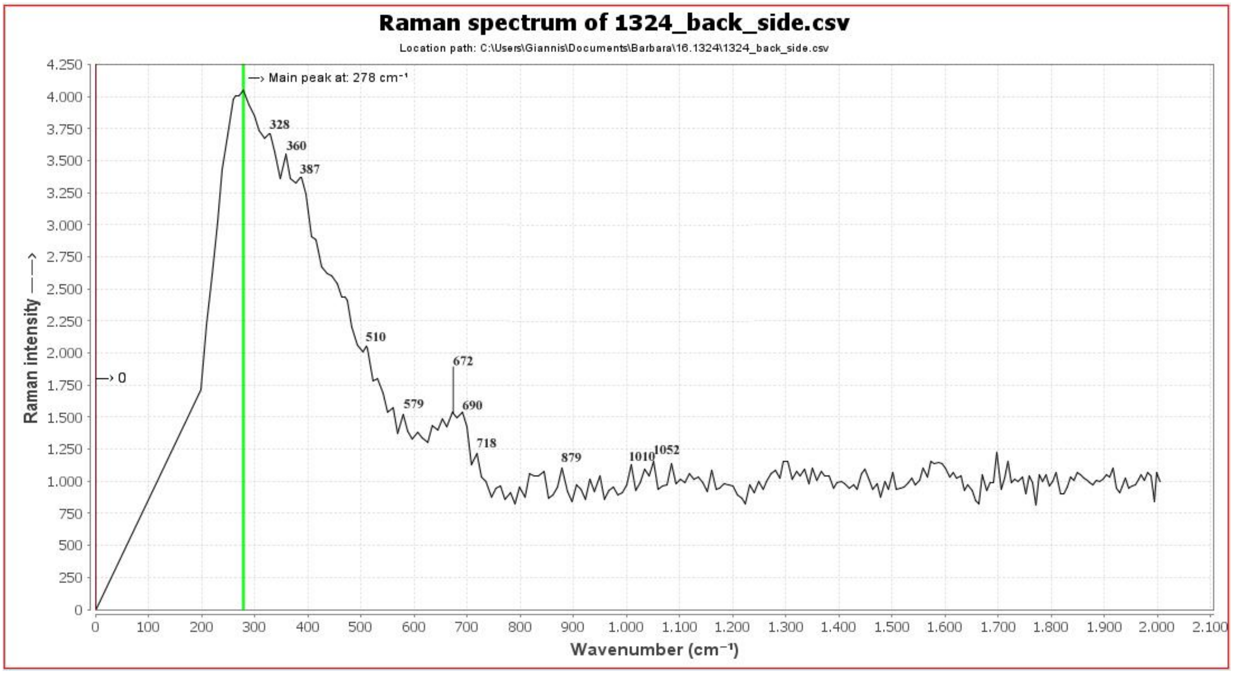
No. 16: CMS II, 3 No. 35 (UnS No. 33)

		Onassoglou (1985, p. 232, no. 10): steatite A: steatite or serpentine
Seal	Impression	

Raman spectroscopy analysis



The Raman bands at: 360-365, 450, 672, 1052 and 1381 cm^{-1} indicate the presence of steatite (talc) and, the Raman band at 674 cm^{-1} corresponds to the symmetric Si-O-Si bending vibration which is characteristic for this mineral. Apart from the indication of steatite, other vibrational bands are present: the Raman bands at: 328, 397, 510. 560 and 670 cm^{-1} indicate the presence of diopside. The bands at 326, 670 and 1012 (not clear) cm^{-1} are the dominant bands and indicative for this mineral. Mohs' scale hardness: 5.5-6.5. It must be noted that diopside can be found as a component mineral in other serpentinised or steatified rocks, i.e. experimental pseudo-morphism of diopside by talc and serpentine in (Ni, Mg)Cl 2 aqueous solutions. Finally, the bands at 387 (v_5(e) SiO4) and 692 (v_s Si-O-Si) cm^{-1} present in the spectra of seal-stone 1324 are the dominant Raman bands for chrysotile which is one of the three polymorphs of serpentine group of minerals. Mohs' scale hardness: 2.5-3.



<u>Result</u>

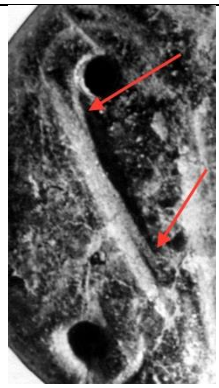
Minerals: steatite, diopside and chrysotile

Name of the stone: it cannot be defined

Mohs' scale hardness: 1

<u>Analysis of the engraving</u>

Concerning the cuts, the central stroke creating the body of the cuttlefish is usually composed by a single cut in the hard stone seal but in this case it is composed by more than one stroke (Fig. 1).

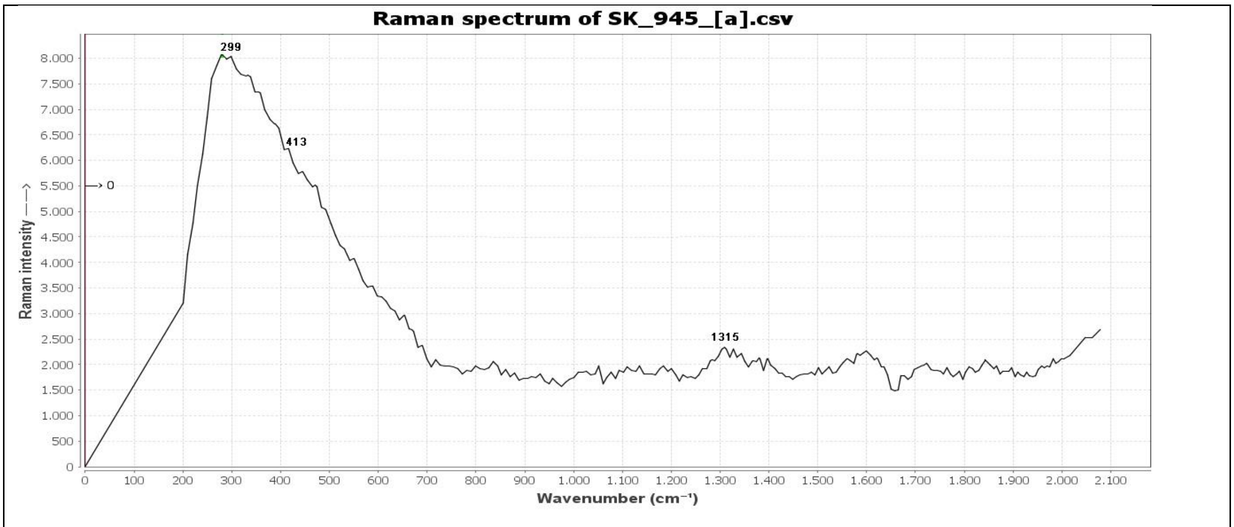
	
Fig. 1	Fig. 2

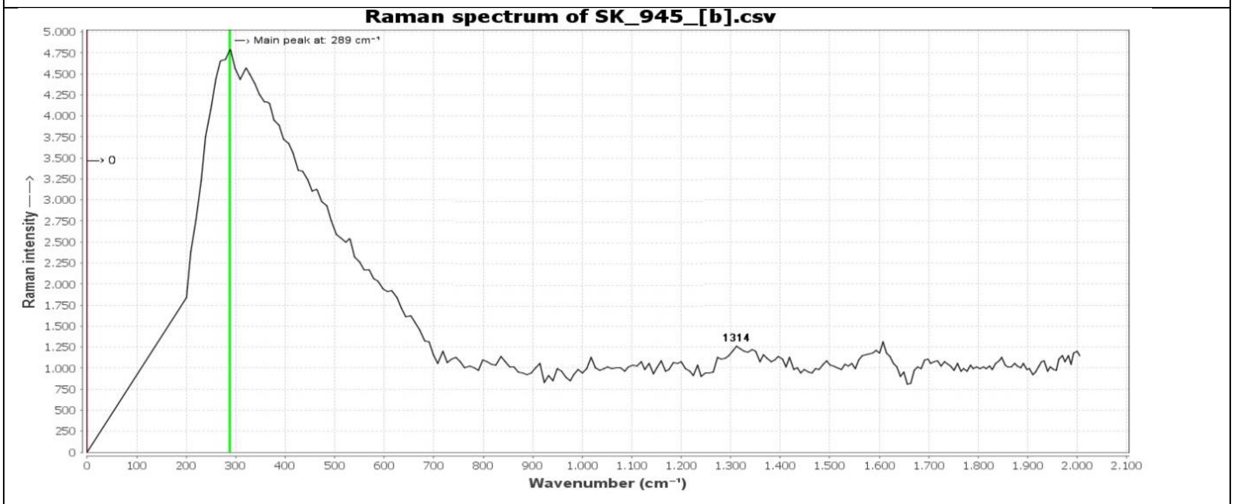
This means that the freehand technique is involved. Moreover, both the interconnective lines which create the S-shaped cut are not created by a single cut but by more than one line (Fig. 2), meaning we are dealing with a soft material.

No. 17: CMS II, 3 No. 365 (UnS No. 34)

 	 	Onassoglou (1985, p. 235 no. 52): hematite ARACHNE: jasper (?)
Seal	Impression	

Raman spectroscopy analysis





For this seal it was not possible to collect satisfactory (resonant) spectra. However, the dominant Raman bands of hematite (a-Fe_2O_3) were identified at 413 and 1315 cm^{-1}

which is also noted for one of the secondary bands observed at 290 cm^{-1}. Mohs’ scale hardness: 5.5-6.5.

Result

Mineral: hematite

Name of the stone: hematite

Mohs’ scale hardness: 5.5-6.5.

Analysis of the engraving

As seen in the previous example, the engraving on this stone is very clear. In fact, the usual central cut which composes the body of the figure was made by one stroke of the cutting wheel.

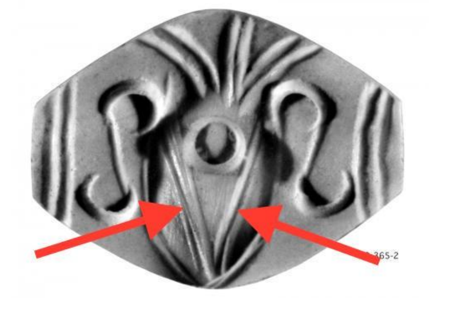


Fig. 1

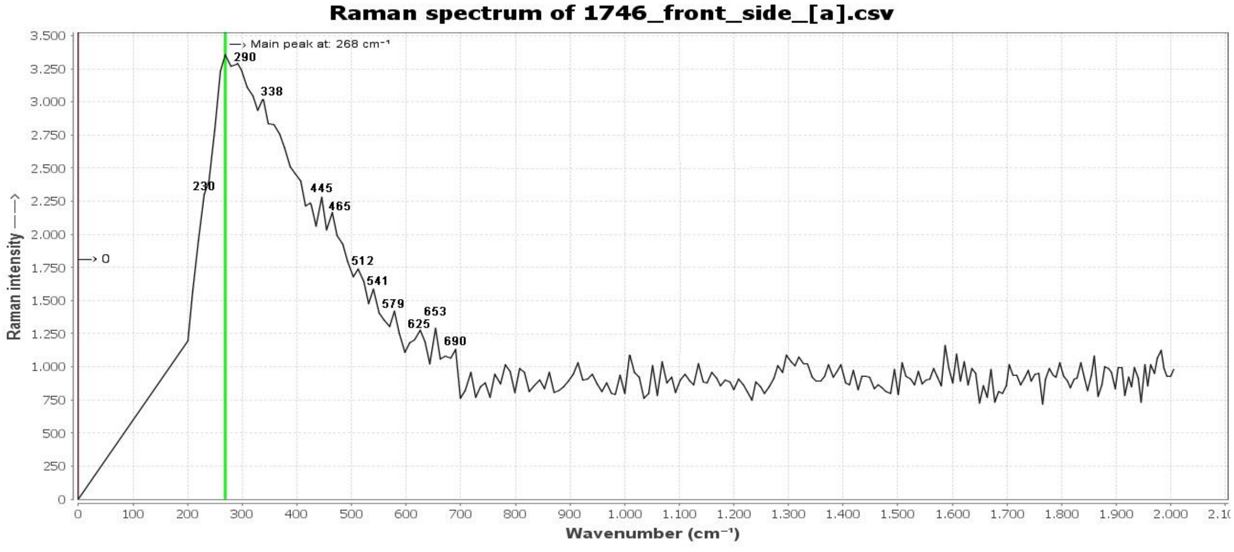
Fig. 2

On this first cut, other lines were overlapped such as little oblique lines (Fig. 1) and a circle (Fig. 2) without breaking the seal-surface which is quite homogenous. These characteristics belong to mechanical technique applied on a hard stone.

No. 18: CMS II, 3 No. 143 (UnS No. 35)

		Onassoglou (1985, p. 23 no. 13): steatite ARACHNE: steatite or serpentine
Seal	Impression	

Raman spectroscopy analysis



The bands at 268 and 445 cm^{-1} correspond to the dominant Raman bands of brucite ($Mg(OH)_2$) which is one of the two component minerals of serpentines. The Raman band at 653 cm^{-1} is associated with the bending modes of the O-Si_b-O units of the 6- and 8-membered rings of the [$Si_{10}O_{28}$] unit. The Raman bands at 339 and 456 cm^{-1} can be assigned to SiO_2 bending modes of chrysotile and lizardite, yet the Raman band at 512 cm^{-1} is attributed to SiO_4 deformation modes and is characteristic of lizardite. The Raman band at 625 cm^{-1} corresponds to an antisymmetric translation mode of OH-Mg-OH while the band at 690 cm^{-1} can be attributed to O-Si_b-O bending mode in chrysotile and lizardite. Mohs' scale hardness: 3 to 4.

Result

Minerals: serpentine, chrysotile, lizardite

Name of the stone: serpentinite

Mohs' scale hardness: 2.5-4

<u>Analysis of the engraving</u>

This seal presents a few cuts and the central line is very thin. Looking at this mark it can be seen that two straight lines appears on its impression (Fig. 1) so it could have been engraved by a knife.

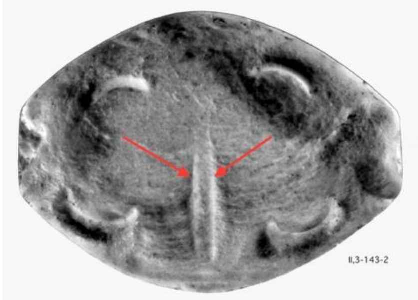
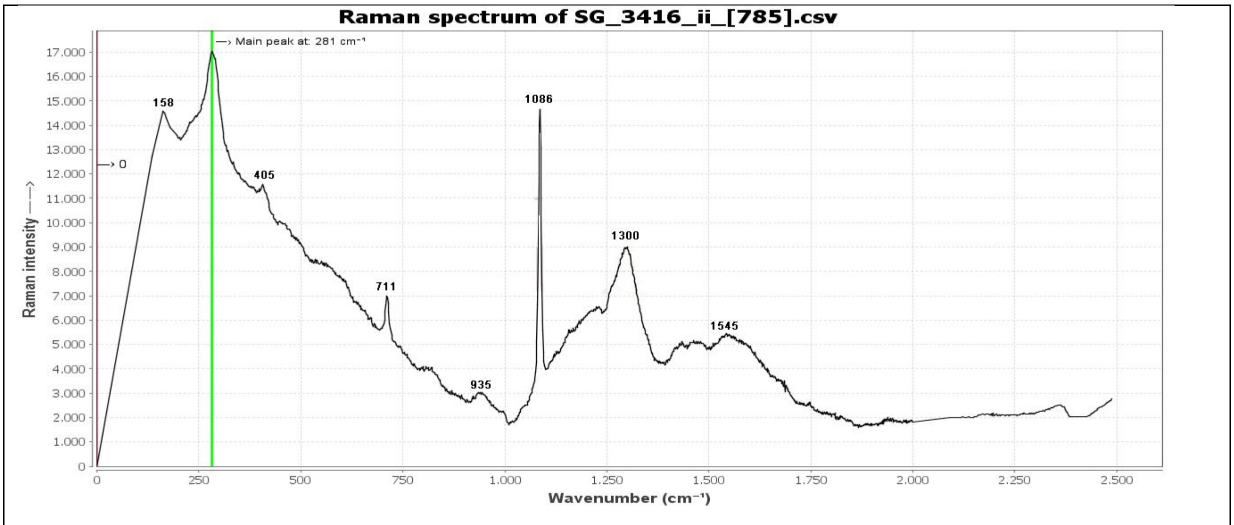


Fig. 1

No. 19: CMS III No. 280 (UnS No. 79)

		Onassoglou (1985, p. 236 no. 57): Jasper ARACHNE: limestone
Seal	Impression	

Raman spectroscopy analysis



The Raman band at 158 and 280 cm^{-1} can refer to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (asymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion. The Raman bands observed in all the spectra (with both 785 and 1064 nm excitation laser) from this item are the characteristic bands of calcite ($CaCO_3$), which is the dominant mineral of limestone. Mohs' scale hardness of calcite: 3.

The Raman bands at 1300 and 1545 cm^{-1} are indicative of the presence of carbonaceous matter which explains the dark colour of the stones. Furthermore, there are also indications of the presence of lawsonite due to the presence of the Raman bands at 208 and 935 cm^{-1}. Nevertheless, the absence of the characteristic band of this mineral at 670 cm^{-1} cannot confirm its presence in this item.

Result

Not clear

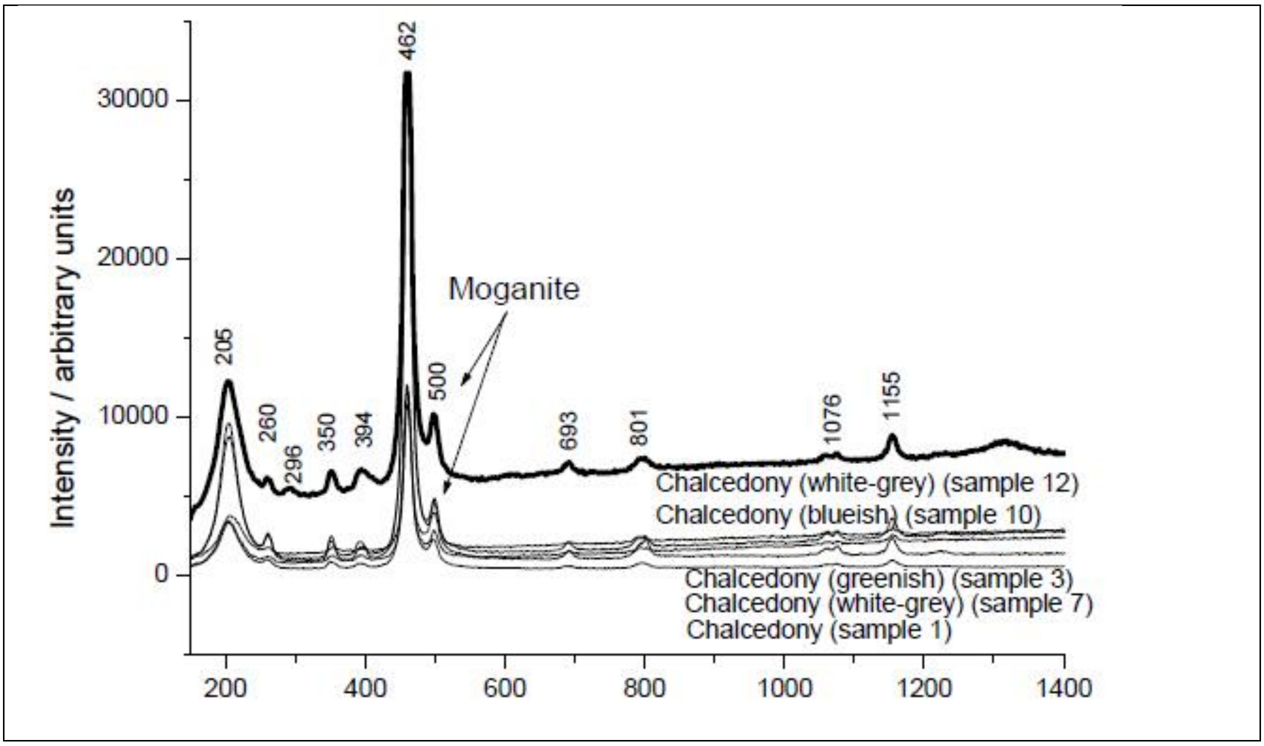
Analysis of the engraving

The seal-surface is not smooth as usually seen in hard stones and, therefore, this may be evidence of a soft stone. Concerning the cuts, they were juxtaposed with a certain degree of symmetry; however they do not seem to be engraved with rotary tools. The engraving it is hard to judge without a deeper analysis of the tool marks with the use of a microscope.

No. 20: CMS II, 3 No. 26 (UnS No. 42)

		Onassoglou (1985, p. 240 no. 5): agate ARACHNE: Carnelian (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The Raman spectrum of this item with the dominant vibrational band centred at 463 cm^{-1} and bands at 213, 350, 394 cm^{-1} identifies α-quartz (trigonal SiO_2). The band (shoulder) at 502 cm^{-1} seems to be the only visible band of moganite (monoclinic SiO_2) and corresponds to Si-O-Si vibration. The identified minerals are characterised by almost the same vibrational bands and the presence of quartz can be reliably established not only through the dominant band at 463 cm^{-1} but also by the band at 353 cm^{-1}.

Based on the macroscopic appearance, the colour of the stone corresponds to a microcrystalline variation of SiO_2- chalcedony, more accurately carnelian. Mohs' scale hardness: 6-7. Carnelian belongs to fibrous varieties of quartz. In this case, the Raman spectrum is affected by photoluminescence, which is likely to reflect the presence of ferrous compounds. The reddish-orange or brownish-orange colour is due to the traces of ferric oxide and hematite (Fe_2O_3), although the characteristic Raman bands were not identified in the spectra collected from this sample.

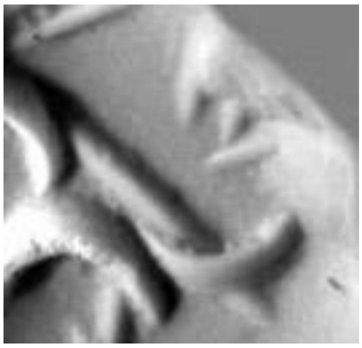
<u>Result</u>

Mineral: moganite

Name of the stone: carnelian

Mohs’ scale hardness: 6-7

Analysis of the engraving

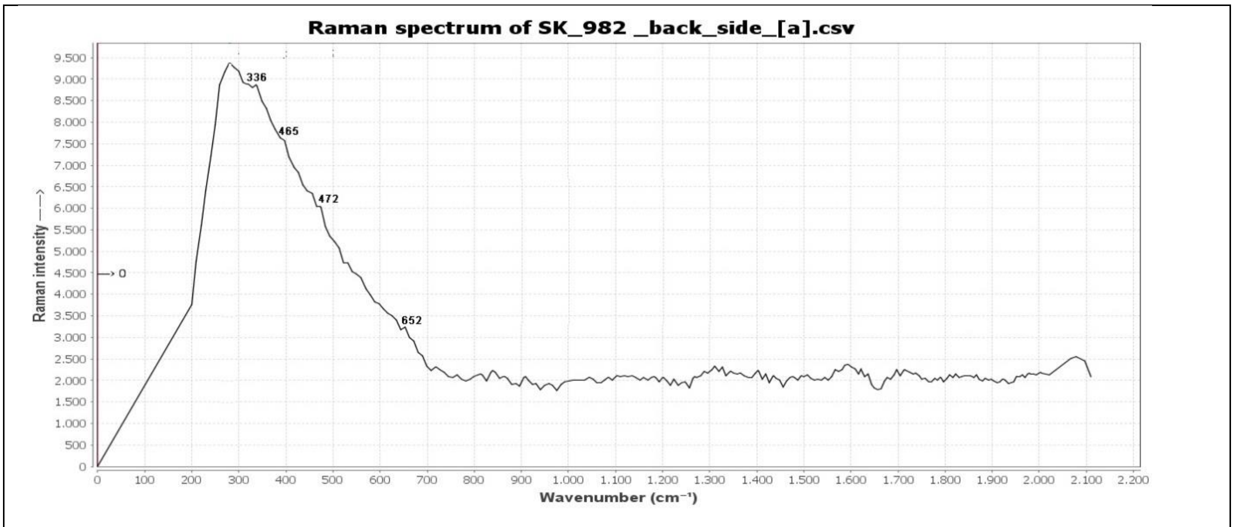
	
Fig. 1	Fig. 2

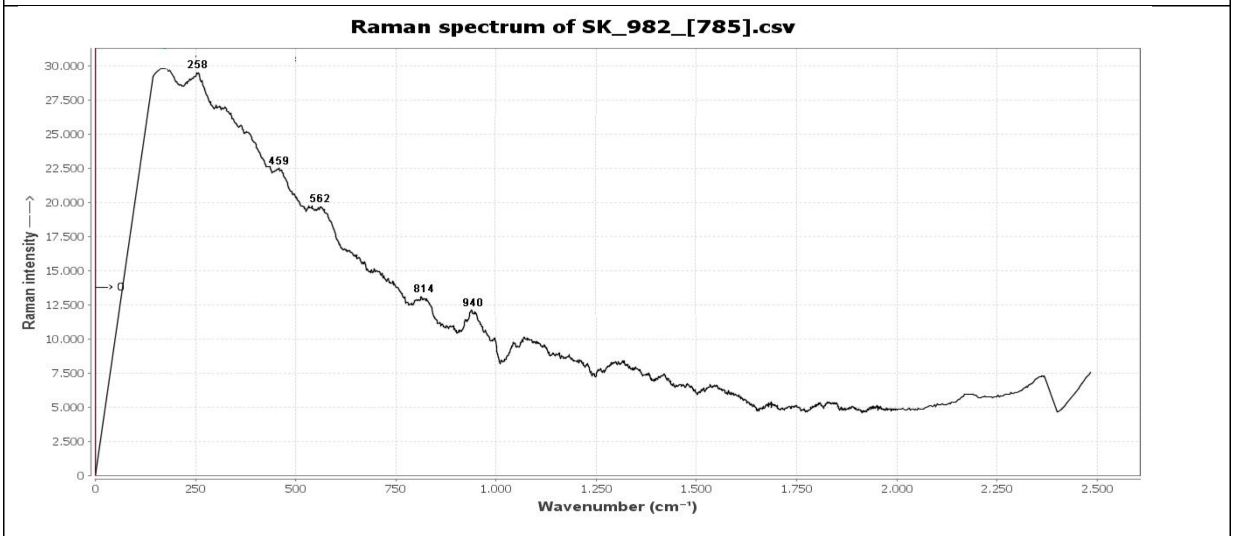
The seal-surface is very smooth and the cuts are very clear. In this case it is not possible to see if they are overlapped (Figs. 1-2) as usually happens when rotary tools on hard stones are involved.

No. 21: CMS II, 3 No. 369 (UnS No. 44)

		Onassoglou (1985, p. 242 no. 11): jasper ARACHNE: jasper (?)
Seal	Impression	

<ins>Raman spectroscopy analysis</ins>





The Raman spectra acquired from this item are not adequately resonant and, thus, the bands cannot be safely assigned to characterise the material. However, it is possible to attempt an interpretation: the characteristic vibrational bands in the region of 460 cm^{-1} can be assigned to α-quartz (trigonal SiO_2) and, additionally, the Raman and bands at 393, 353 cm^{-1} can be also attributed to α-quartz.

The Raman bands which appear at 940, 562, 459 cm^{-1} are indicative of the presence of the calcium aluminium sorosilicate (isolated double tetrahedra groups with $(Si_2O_7)^{6-}$) mineral lawsonite. The band at 940 cm^{-1} is one of the two dominant characteristic vibrational bands of this mineral. The bands lying in the frequency range 600 – 1100 cm^{-1} have been attributed to specific stretching vibrations of the Si_2O_7 units present in the structure.

In terms of hardness, the identification/presence of this mineral does not affect the magnitude of our sample significantly, since its hardness is 7.5. Regarding lawsonite, it is a metamorphic mineral typical of the blueschist facies. It also occurs as a secondary mineral in altered gabbro and diorite.

<u>Result</u>

Mineral: lawsonite

Name of the stone: it may be jasper

Mohs' scale hardness: 7.5.

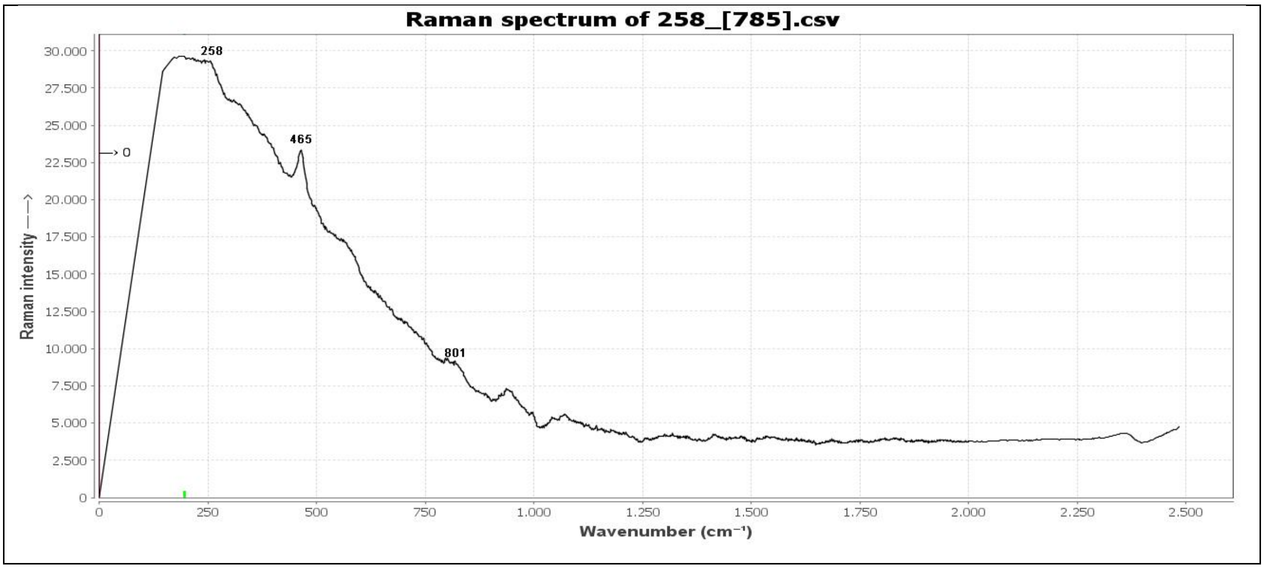
<u>Analysis of the engraving</u>

As seen in the previous example, in this case the tool marks confirm that this stone is hard based on their characteristics, as well as the homogenous seal-surface.

No. 22: CMS IV No. 226 (UnSCO No. 1)

		Onassoglou (p. 209 KO-44, p. 264 KO-44): sardonyx ARACHNE: agate
Seal	Impression	

<u>Raman spectroscopy analysis</u>



In all the spectra acquired from this seal, α-quartz (SiO_2) is the dominant mineral. The characteristic band for all micro and cryptocrystalline quartz minerals appears at 465 cm^{-1}.

Chalcedony is a general term referring to aggregates of parallel grown (“fibrous”) quartz crystals of microscopic and sub-microscopic size. Sard is a type of solid-coloured chalcedony quartz, while sardonyx is a type of banded agate. Agate and onyx are both varieties of layered chalcedony that differ only in the form of the bands: agate has curved bands and onyx has parallel bands. In terms of hardness on the Mohs’ scale, they all are within the range of 6-7.

One Raman band at 940 cm^{-1} could be attributed to lawsonite but there is no adequate data to support this option.

<u>Result</u>

Mineral: α-quartz

Name of the stone: agate

Mohs' scale hardness: 5-6

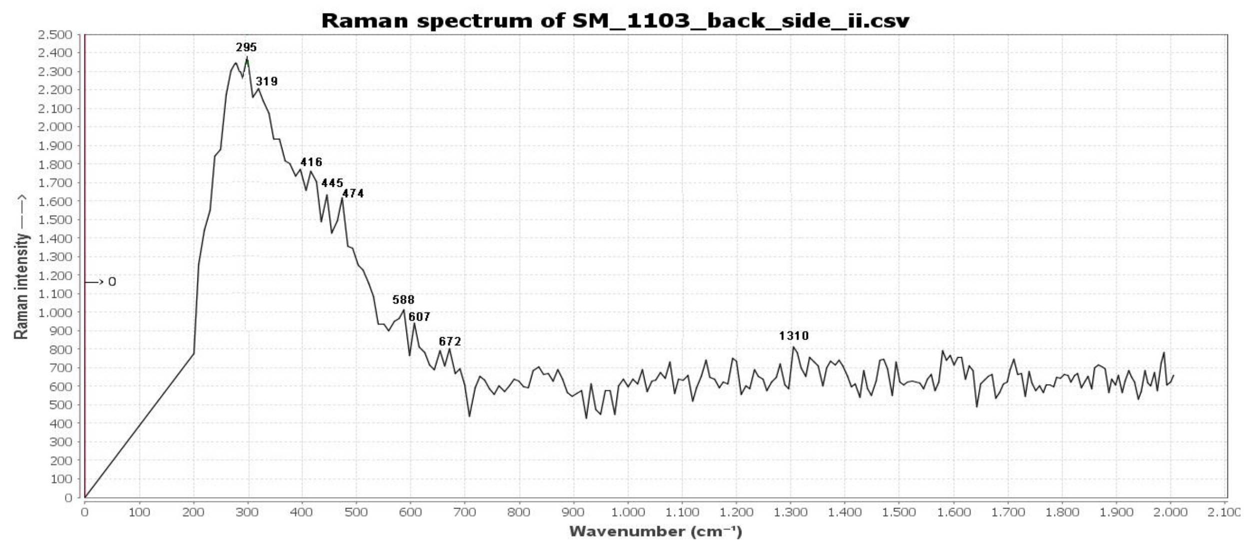
<u>Analysis of the engraving</u>

The deep and clear marks can be attributable to the use of rotary tools or drills, which in this seal were used twice in the central part of the figure.

No. 23: CMS IV No. 241 (UnS No. 46)

		Onassoglou (1985, p. 256 no. 49): marble ARACHNE: middle hard stones
Seal	Impression	

<u>Raman spectroscopy analysis</u>



In the Raman spectra acquired from this seal, the dominant Raman bands of hematite (a-Fe2O3) were identified at 413 and 1310 cm^{-1} and, one of the secondary bands of hematite can be observed at 290 cm^{-1}. Mohs' scale hardness: 5.5-6.5.

Additionally, some bands of glaucophane are present at 670 (dominant/characteristic of this mineral), 445, 474 cm^{-1}. Glaucophane ($Na_2(Mg_3Al_2)Si_8O_{22}(OH)_2$) belongs to the family of double chain inosilicates. The hardness of hematite and glaucophane are of the same order of magnitude, ranging between 5.5-6.5 in the Mohs' scale.

<u>Result</u>

Mineral: hematite/glaucophane

Name of the stone: hematite

Mohs' scale hardness: 5.5-6.5

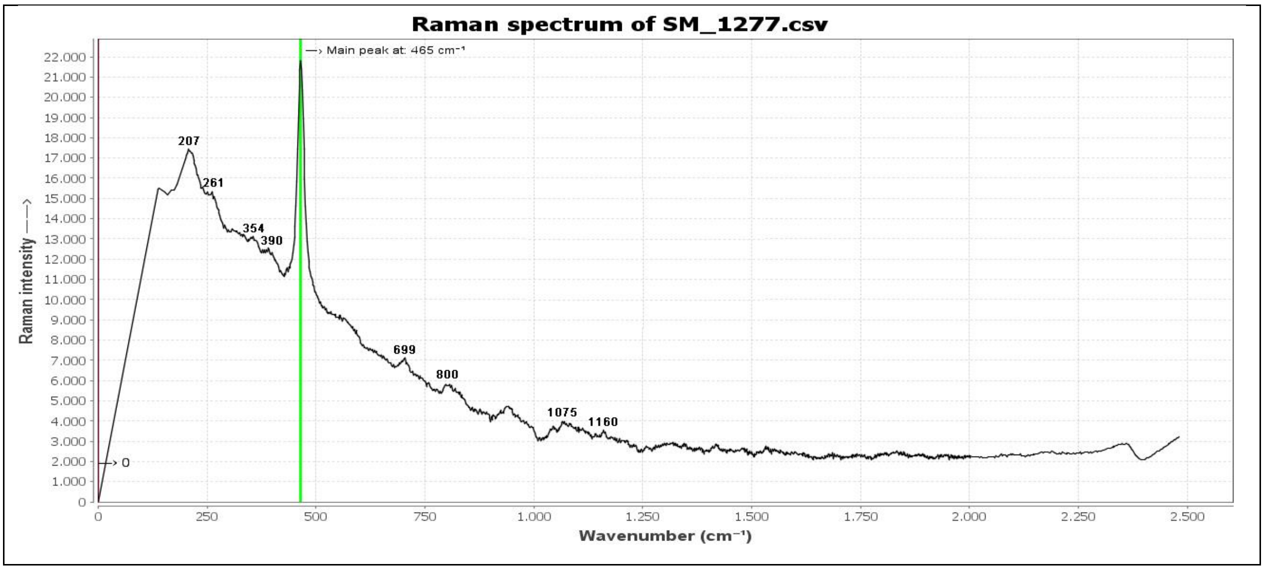
Analysis of the engraving

The tool marks visible on this seal entirely confirm the use of a mechanical device. The use of the broad wheel for the two main cuts disposed on the central part of the seal-surface is clear as is the use of the thin wheel which was used to create straight lines on them. The fact that these cuts are difficult to create on a very breakable seal in soft material and the clear visibility of the sequence of the construction of the figure confirm the presence of a hard material.

No. 24: CMS IV No. 41D (UnS No. 55)

		Onassoglou (1985 p. 266 no. 11): marble ARACHNE: hard stone
Seal	Impression absent from ARACHNE	

Raman spectroscopy analysis



The Raman spectrum of this seal with the dominant vibrational band centred at 465 cm^{-1} and bands at 207, 361, 354, 390 cm^{-1} identifies α-quartz (trigonal SiO_2). This is a typical Raman spectrum of jasper which is a variety of chalcedony. The identified minerals are characterised by almost the same vibrational bands and the presence of quartz can be reliably established not only through the dominant band at 465 cm^{-1} but also by the band at 355 cm^{-1}. Mohs' scale hardness: 6-7. Excitation source: λ=785 nm. The characteristic Raman band at 465 cm^{-1} dominates the spectrum acquired with the 1064 nm laser as well.

Result

Mineral: moganite

Name of the stone: chalcedony

Mohs’ scale hardness: 6-7

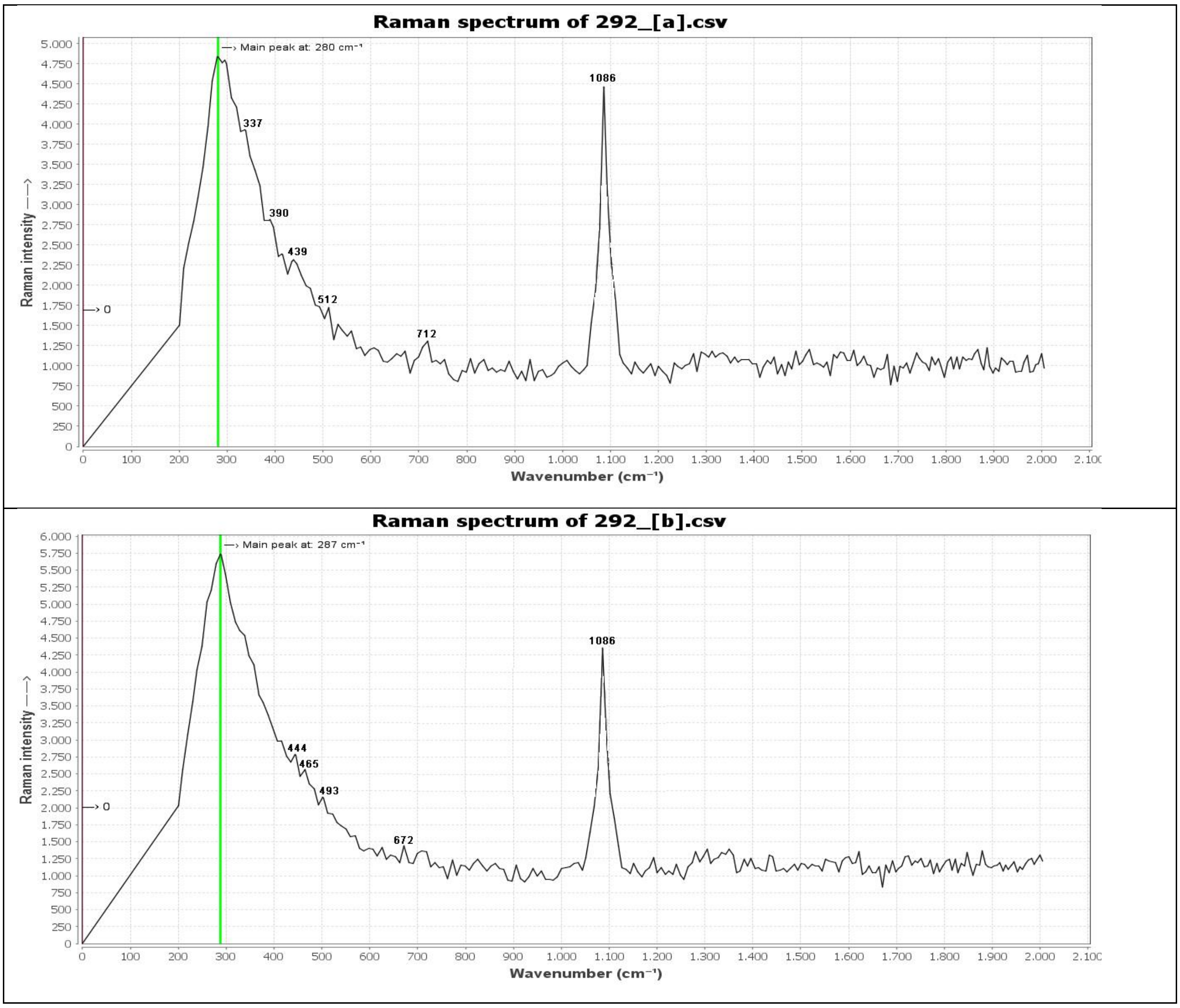
Analysis of the engraving

This example shows the use of the drills which created very deep and clear holes on the seal-surface. The use of the cutting wheel is clear based on a series of lines characterised by the same thickness.

No. 25: CMS IV No. 180 (UnS No. 57)

		Onassoglou (1985, p. 230 no. 13): agate ARACHNE: agate (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The Raman band at 280 cm^{-1} can refer to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1086 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion. All the Raman active bands of calcite have been identified. In both Raman spectra of 292 the vibrational band at 465 cm^{-1} is indicative of α-quartz (trigonal SiO_2) so that this can be attributed to the presence of agate. The band observed at 502 cm^{-1} is the distinctive band of moganite (monoclinic SiO_2) and corresponds to Si-O-Si vibration.

The peaks below 400 cm^{-1} originate from torsional vibrations and O-Si-O bending modes. The stronger bands in the spectra, which occur in the range of 465 and 530 cm^{-1} involve motions of O in Si-O-Si symmetric stretching-bending modes. The identified minerals are characterised by almost the same vibrational bands and the presence of quartz can be reliably established not only through the dominant band at 465 cm^{-1} but also by the band at 355 cm^{-1}. The Raman bands observed at 672, 493, 444 and 337 cm^{-1} can be attributed to glaucophane with the dominant/characteristic at 672 cm^{-1}. Excitation source: λ=785 nm. The dominant Raman band at 1086 cm^{-1} is characteristic of calcite, calcium carbonate ($CaCO_3$). The secondary bands indicate the presence of silicate minerals (quartz/moganite→ agate=banded chalcedony. Glaucophane).

Result

Minerals: calcite; agate (banded chalcedony)/glaucophane

Name of the stone: it is difficult to define

Mohs' scale hardness: 6 moganite/glaucophane 6; agate 7; calcite 3

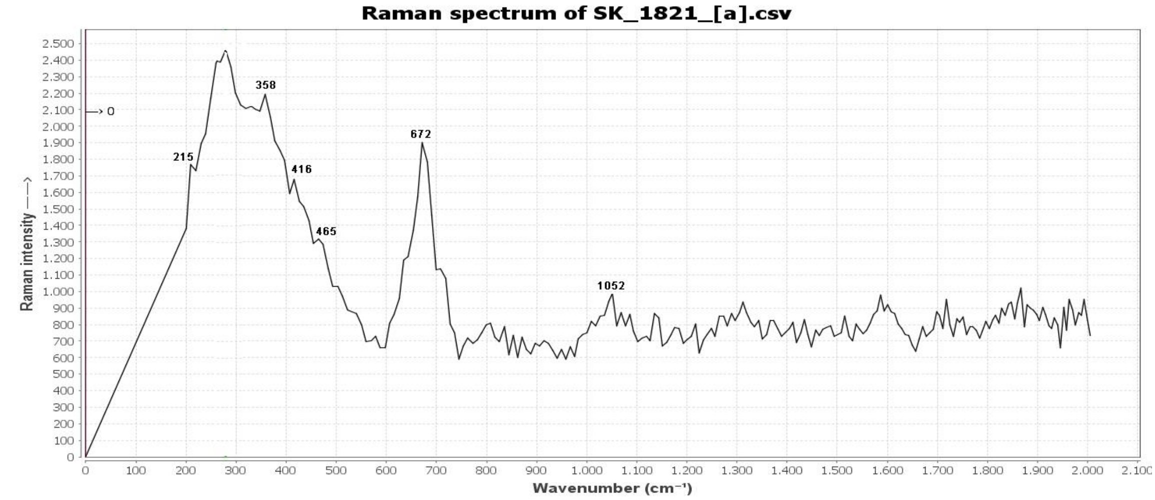
Analysis of the engraving

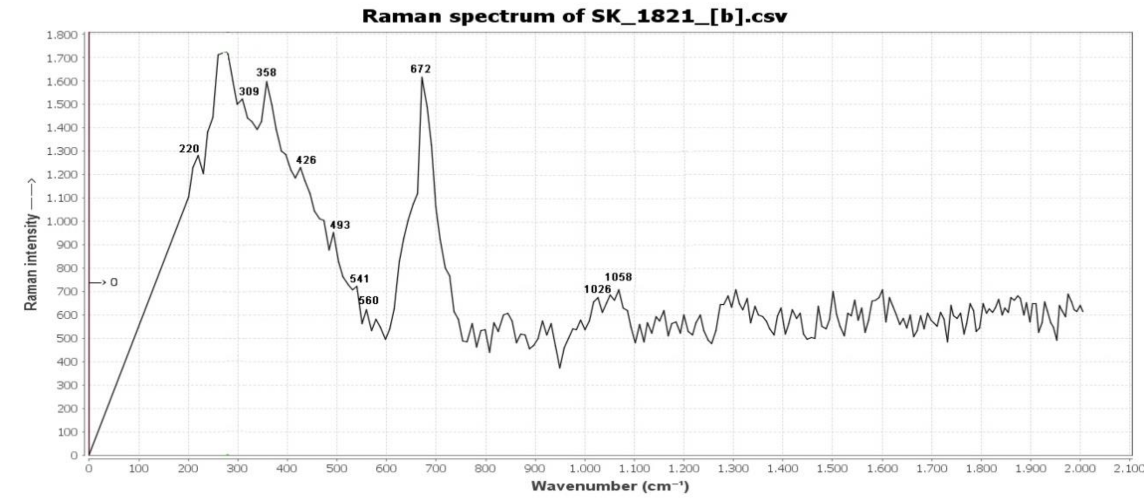
For this stone, it is difficult to attempt interpretation of the cutting given that the picture is not clear.

No. 26: CMS II, 2 No. 149 (UnS No. 59)

		Onassoglou (1985, p. 305 e): ivory ARACHNE: slate (?)
Seal	Impression	

Raman spectroscopy analysis





In both spectra acquired from this seal, two specific dibasic minerals have been identified. The dominant mineralogical phase is actinolite $Ca_2(Mg_{4.5-2}.5Fe^{2+}_{0.5-2.5})Si_8O_{22}(OH)_2$ while there are also indications of diopside ($MgCaSi_2O_6$). Actinolite belongs to the family of chain silicates called pyroxenes.

The dominant band of actinolite is observed at 672 cm^{-1} in all the spectra acquired from this seal. It is assigned to symmetric $Si–O_b–Si$ stretch. In addition to this, two bands are observed at 416 and 358 cm^{-1}. The band observed at 416 cm^{-1} is assigned to an antisymmetric Mg–OH translation mode, whereas the band observed at 358 cm^{-1} is assigned to a symmetric Mg–OH vibration. The band observed at 220 cm^{-1}, is assigned to $(SiO_4)^{4-}$ vibrational modes. The hardness of both minerals is within the range of 5.5 to 6.5 in the Mohs' scale.

Result

Minerals: actinolite, diopside

Name of stone: slate

Mohs' scale hardness: both minerals are within a range of 5.5 to 6.5

Analysis of the engraving

Observing the tool marks, it seems that this seal was engraved by rotary tools as confirmed by the marks left by the tubular drill with the central point.

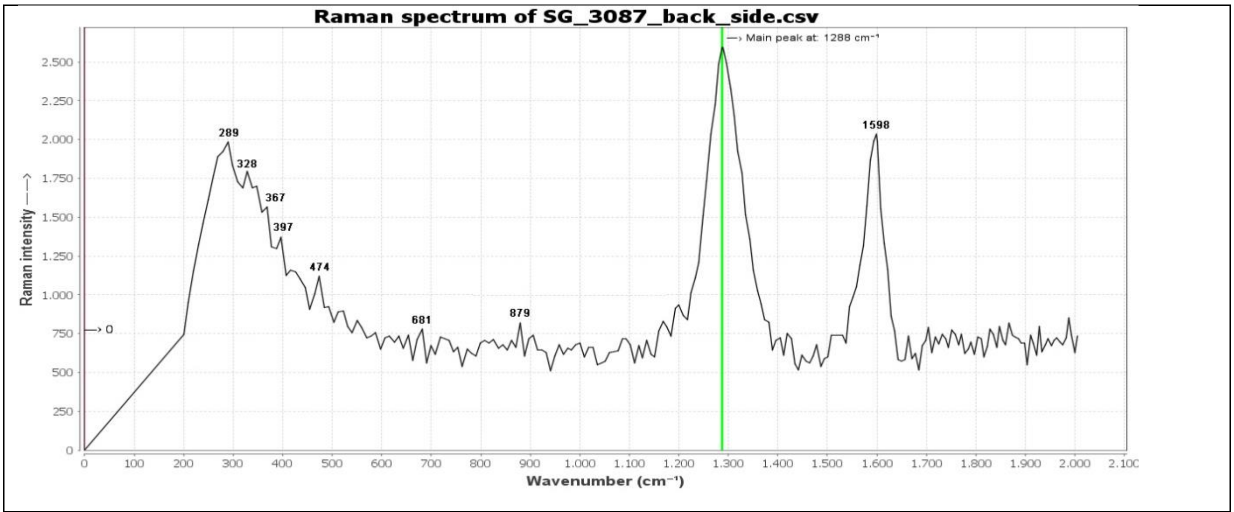
Fig. 1

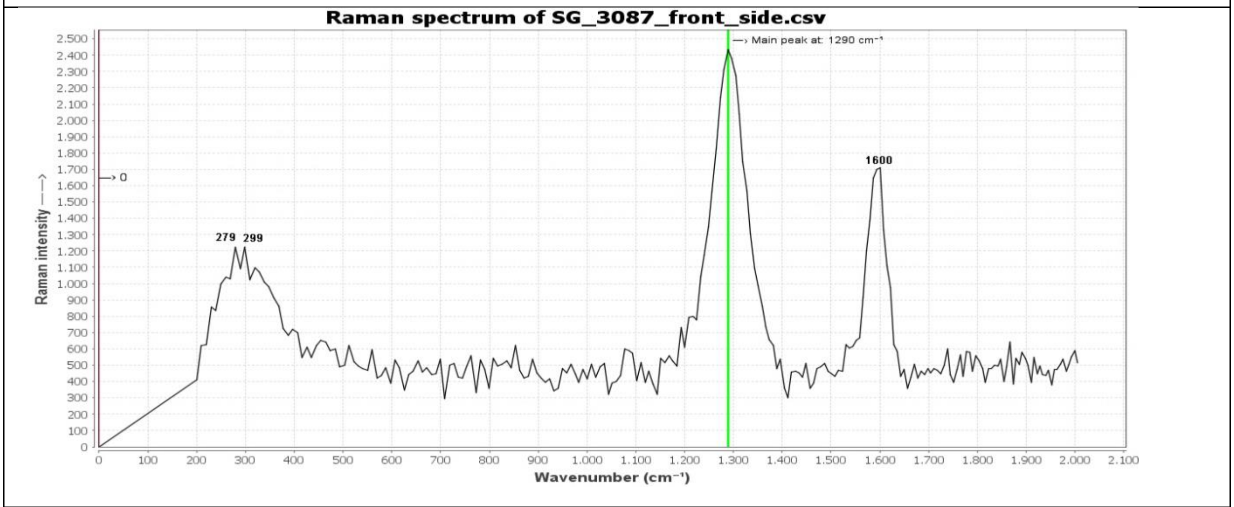
The left straight line disposed on the upper side of the seal-surface presents close little parallel lines slightly visible on its impression (Fig. 1) and this is evidence of the use of the cutting wheel.

No. 27: CMS III No. 273 (UnS No. 60)

		Onassoglou (1985, p. 230 no. 7): hematite ARACHNE: serpentine
Seal	Impression	

Raman spectroscopy analysis





For this seal, there is no indication that allows us to define this stone as hematite. The two dominant bands at 1294 και 1596 cm^{-1} are the G^{+} and D bands of graphite (carbon, hence the black colour). The other minor bands are indicative for the presence of the biotite family of minerals.

Result

Not clear

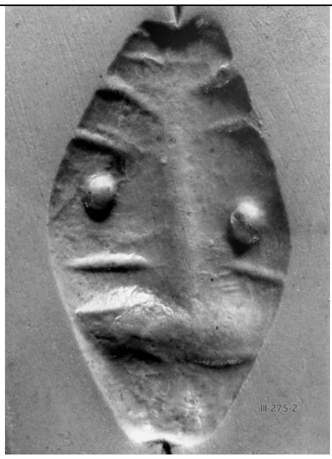
Analysis of the engraving

Overall, the cuts for this stone seem to be very precise and this precision can be seen in the creation of the cross-hatching. The lines which constitute this pattern are the same thickness and all the horizontal lines were precisely overlapped to the previous vertical lines (Fig. 1).

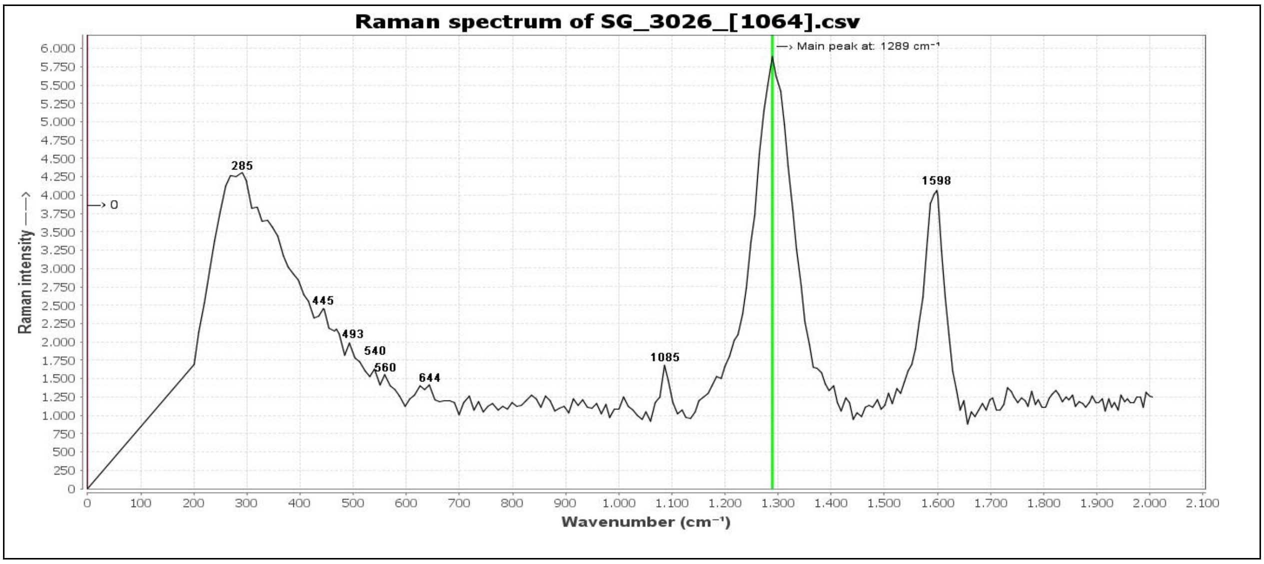
Fig. 1

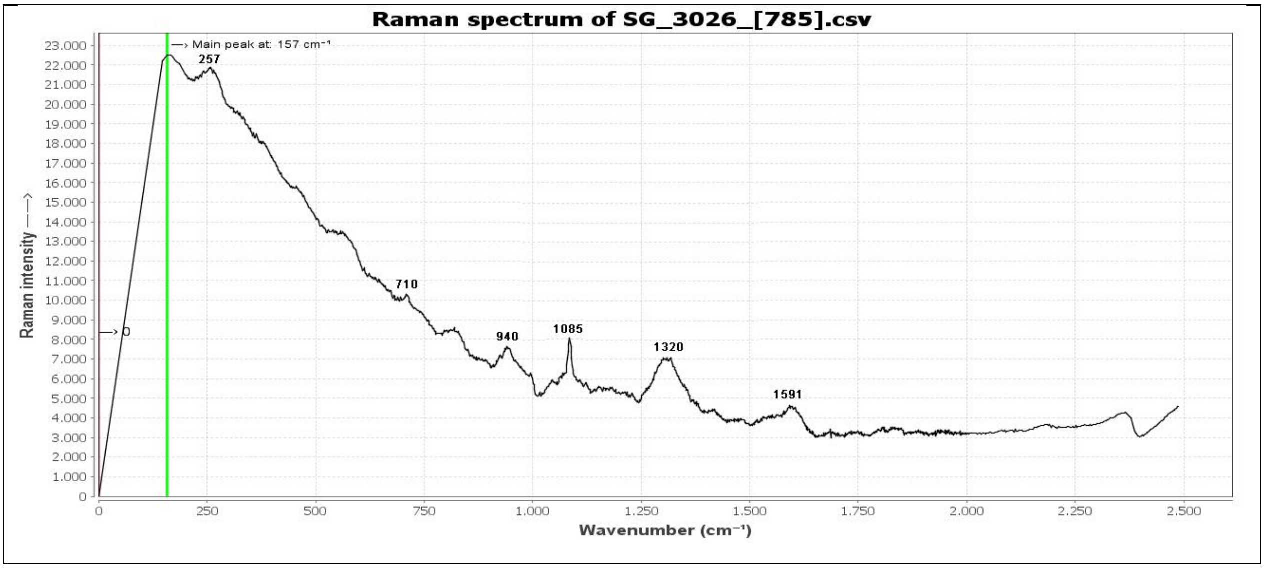
As can be seen, the central vertical cut shows a homogenous surface and this means that the seal was made of hard stone.

No. 28: CMS III No. 275 (UnS No. 61)

		Onassoglou (1985, p. 230 no. 10): steatite ARACHNE: chlorite (?)
Seal	Impression	

<u>Raman spectroscopy analysis</u>





This stone is neither chlorite nor steatite according to the information obtained from the Raman. The two dominant bands at 1294 και 1596 cm^{-1} are the G^+ and D bands of graphite (carbon black). The dominant mineralogical phase is calcite ($CaCO_3$). The Raman band at 280 cm^{-1} can refer to a rotational lattice mode of calcite. The bands located at the 709 – 715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion.

<u>Result</u>

Not clear

<u>Analysis of the engraving</u>

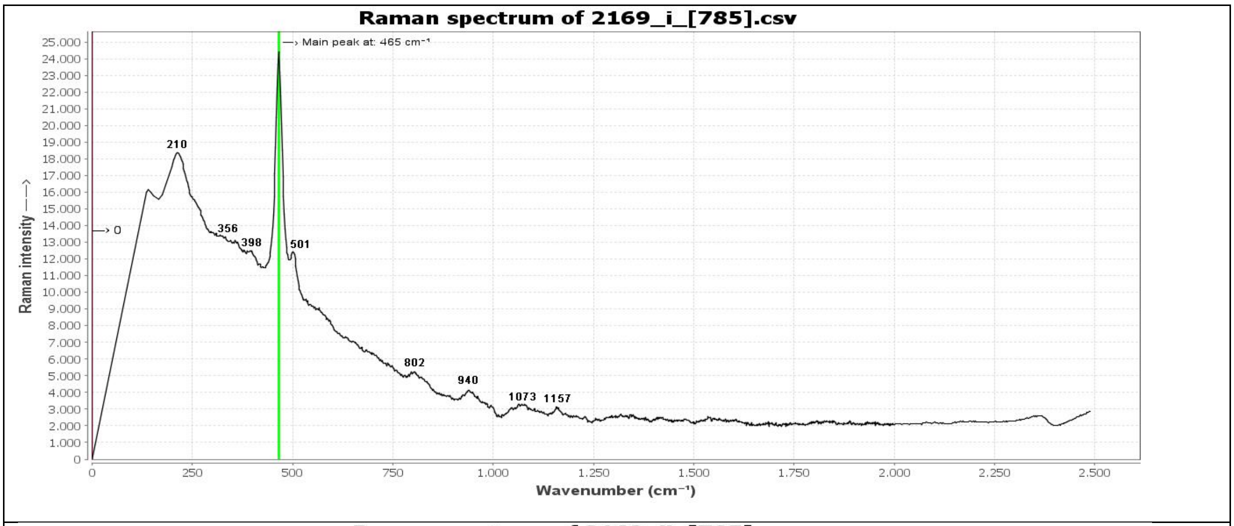
What clearly emerges is that the cuts were not precisely engraved. In fact, the horizontal cut disposed on the lower part of the seal seems to be cut by a knife (Fig. 1) and the same characteristic can be noted for the vertical and central lines disposed on the central part of the seal-surface (Fig. 2). Moreover, the lines disposed on the upper part of the seal-surface do not have the same thickness and they are not straight (Fig. 3). Therefore, all these imperfections may be linked to the softness of the stone.

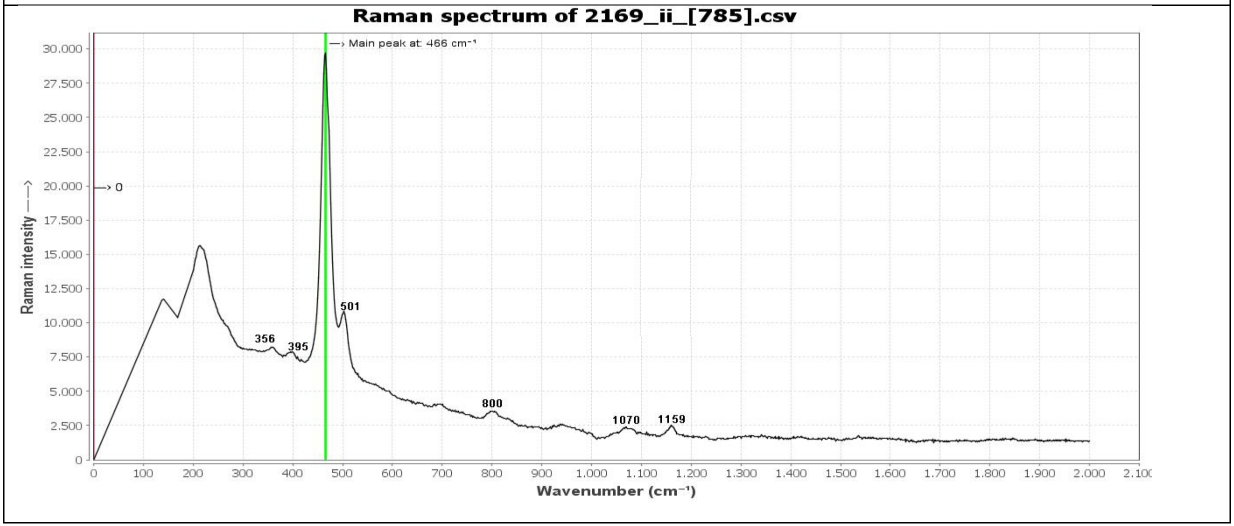
		
Fig. 1	Fig. 2	Fig. 3

No. 29: HMs No. 2169 (UnS No. 66)

Unpublished	Unpublished	Onassoglou (1985, p. 269 no. 20): Carnelian or Sard
Seal	Impression	

<u>Raman spectroscopy analysis</u>





For sample 2169, two polymorphs of quartz (SiO_2) have been identified: α-quartz and moganite. Carnelian is a translucent, bright orange to deep red chalcedony. Strictly speaking, it should not be banded or striated, but very often it is just the orange-red part cut out of a large agate. The name refers to its flesh-red colour.

Sard is a translucent, brown chalcedony. It should not be banded or striated, but very often it is just a brown portion cut out of a large agate. It is also only the tone of the colour that distinguishes carnelian from sard, the latter being browner. The hardness on the Mohs' scale for both carnelian and sard is 6-7. The Raman band at 940 cm^{-1} indicates the presence of lawsonite (hardness 7.5).

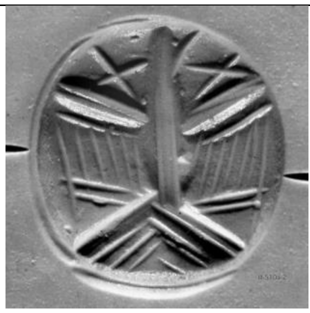
<u>Result</u>

Minerals: α-quartz and moganite

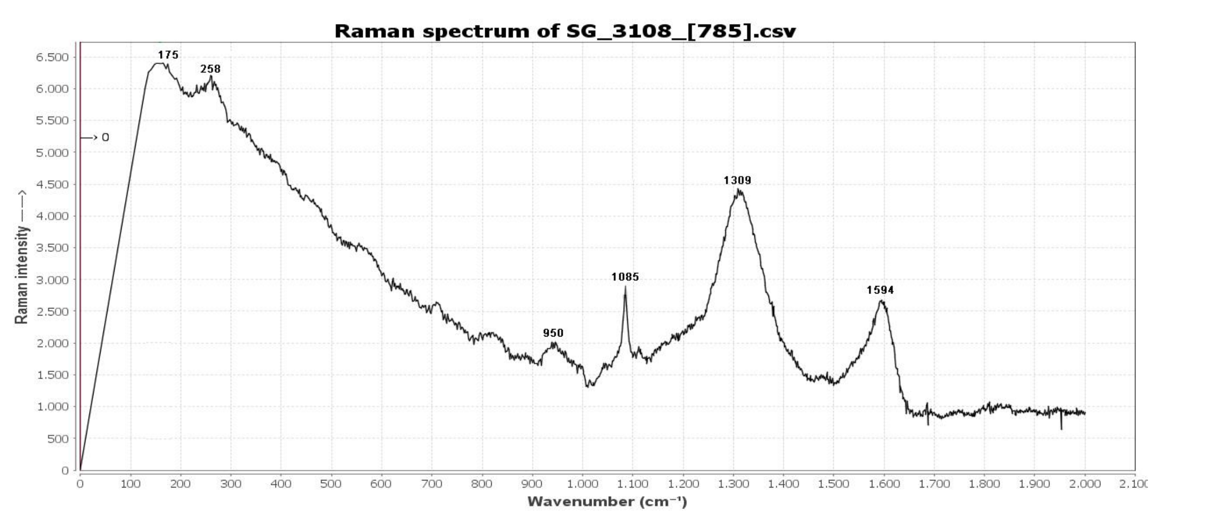
Name of the stone: chalcedony

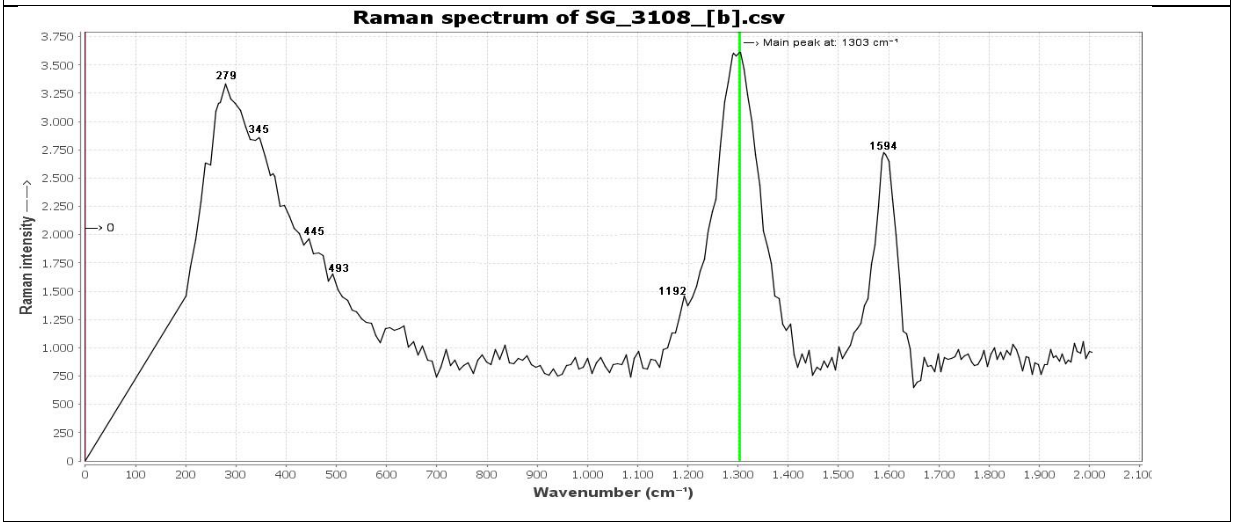
Mohs' scale hardness: 6-7

No. 30: CMS III No. 510 (UnS No. 68)

		Onassoglou (1985, p. 271 no. 35): hematite ARACHNE: hard stone
Seal	Impression	

<u>Raman spectroscopy analysis</u>





Although iron oxides and hydroxides are poor light scatterers, it is possible to characterise such materials reliably at low laser powers. Based on the Raman bands of calcite (characteristic band: 1087 cm^{-1}), it may be marble but only the band at 1085 appears. Also, some iron oxide/hydroxides have bands at 1090, as does graphite (characteristic band: 1598 cm^{-1}).

Result

Not clear but it may be marble

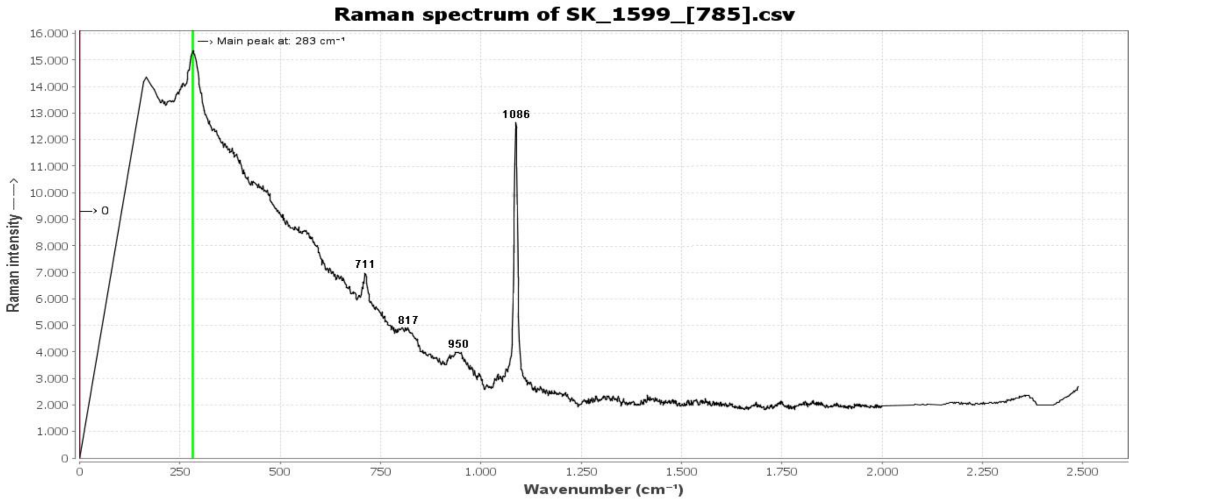
Analysis of the engraving

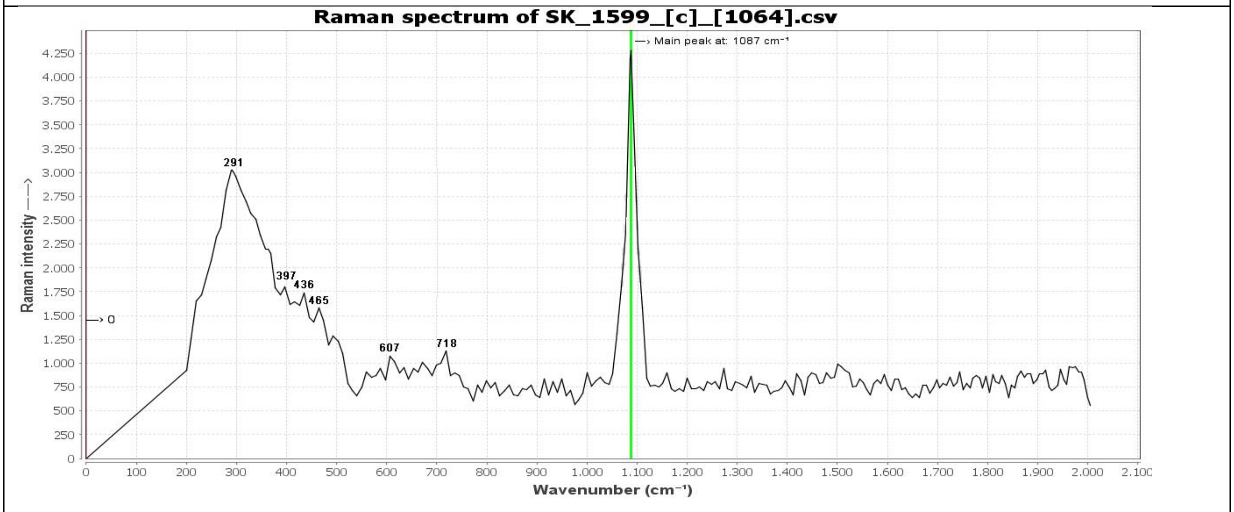
This seal shows clear and precise cuts. The central lines created by a stroke of a cutting wheel was further reworked by a thin wheel which created other two straight lines. Most of the straight lines such as those which create the feather are the same thickness. This evidence indicates that the artisan worked with the same tool (cutting wheel). Finally, the seal-surface is very smooth and it does not present any fracture which is usually linked to soft stones.

No. 31: CMS II, 4 No. 168 (UnS No. 69)

		Onassoglou (1985, p. 272 no. 44): onyx ARACHNE: soft stone
Seal	Impression	

Raman spectroscopy analysis





The dominant mineralogical phase is calcite ($CaCO_3$). The Raman band at 280 cm^{-1} can refer to a rotational lattice mode of calcite. The bands located at the 709-715 cm^{-1} range can be assigned to an internal plane bending of the carbonate anion (antisymmetric stretching deformation of CO_3^{2-}). The intense Raman band at 1087 cm^{-1} is due to a symmetric stretching vibration mode of the carbonate anion. Banded calcite of stalagmitic origin shows patterns similar to onyx which is a silicate mineral.

Result

Mineral: calcite

Name of the stone: onyx

Mohs' scale hardness: 3

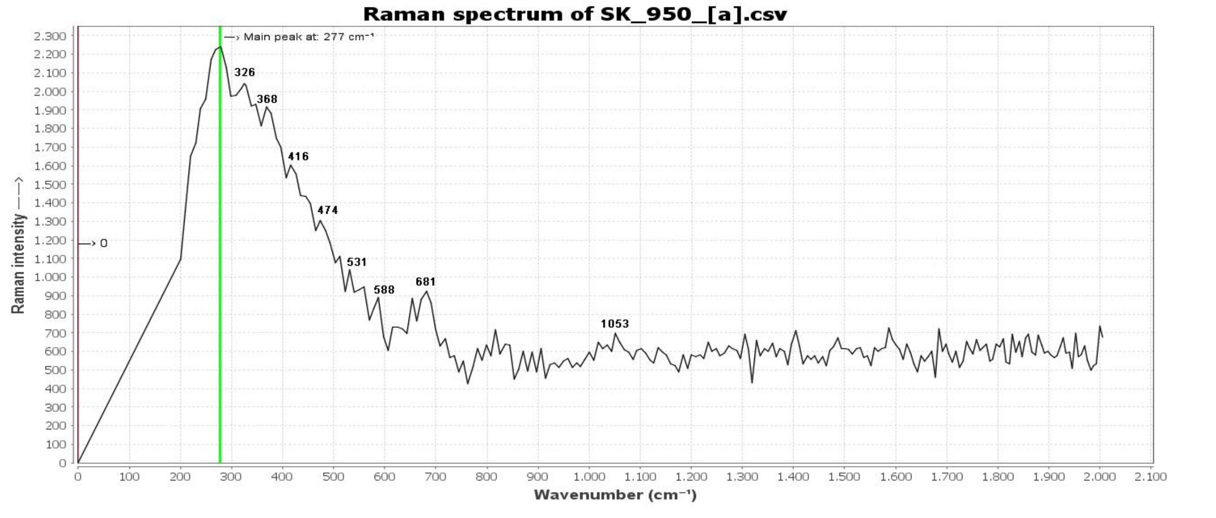
Analysis of the engraving

Generally speaking, the juxtaposition of the cuts which compose the figure are not precise so this is an indication that the freehand technique is involved.

No. 32: CMS II, 3 No. 94 (excluded from the corpus)

		Onassoglou (1985, p. 268 no. 1): serpentine ARACHNE: serpentine or steatite
Seal	Impression	

Raman spectroscopy analysis



The Raman bands at: 368, 470, 681, and 1052 cm^{-1} indicate the presence of steatite (talc). The band at 675 – 680 cm^{-1} corresponds to the symmetric Si-O_b-Si bending vibration and is the characteristic Raman band for this mineral. Mohs' scale hardness: 1

Result

Minerals: brucite with amorphous silicon dioxide

Name of the stones: steatite

Mohs' scale hardness: 1

Analysis of the engraving

According to what can be seen on the impression, the cuts confirm the softness of this stone because they are not precise, especially those which compose the wings of the bird (Fig. 1).

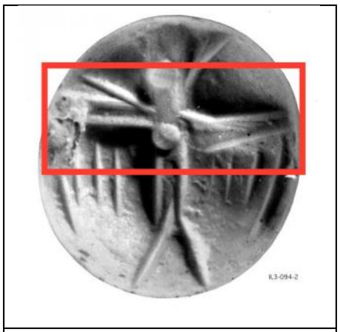


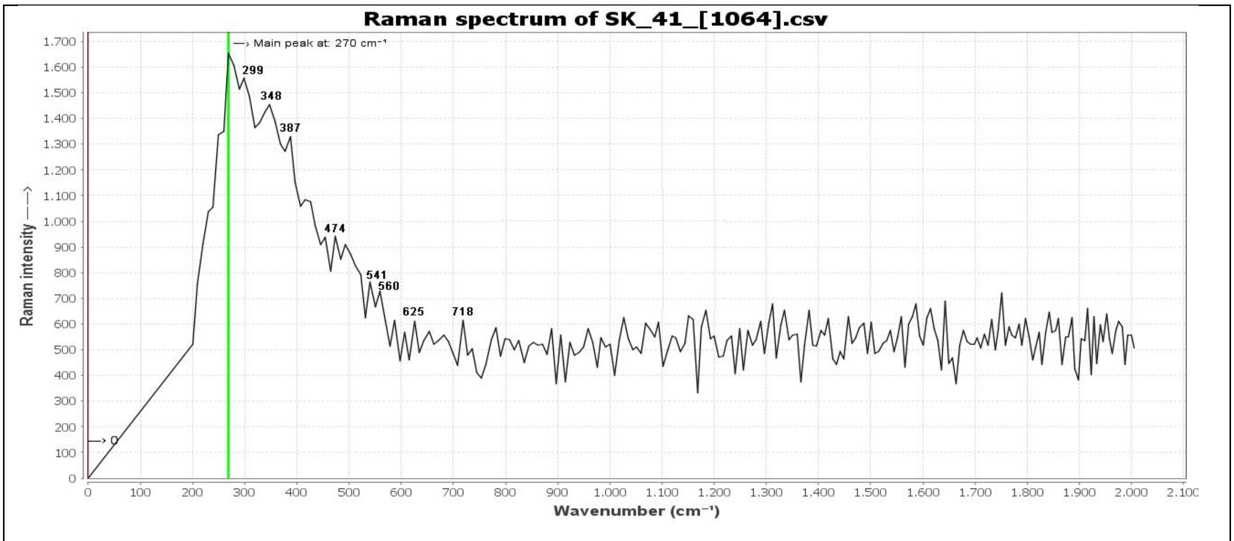
Fig. 1

In fact, the wings are usually created by one stroke of the cutting wheel while in this case the asymmetry depends on the absence of this tool.

No. 33: CMS II, 3 No. 356 (excluded from the corpus)

		Onassoglou (1985, p. 269 no. 12): steatite ARACHNE: steatite or serpentine
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The Raman bands at 299, 348 and 389 cm^{-1} can be assigned to SiO_2 bending modes of chrysotile and lizardite. Although the second dominant band is not present in the spectrum, the bands recorded indicate the presence of serpentine group minerals. Mohs' scale hardness: 2.5-3. There is also an indication of diopside ($CaMgSi_2O_6$: SiO_2: 54.6%, CaO:25.88%, MgO: 18.78%) at 297 or 550 cm^{-1}. Mohs' scale hardness: 5.5-6.5.

<u>Result</u>

Minerals: chrysotile/lizardite with indication of serpentinite

Name of the stone: serpentinite

Mohs' scale hardness: 2.5-3

Analysis of the engraving

The cuts engraved on this seal clearly are not characterised by linearity, for instance the last elongated cut which composes the feather on the right side of the figure. This cut is curved (Fig. 1) because it was not created by the cutting wheel but it was made freehand.

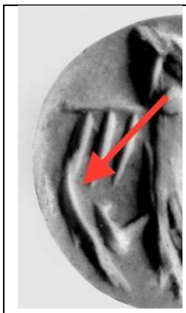
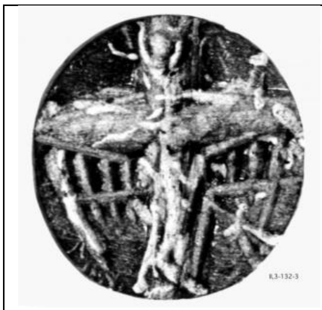


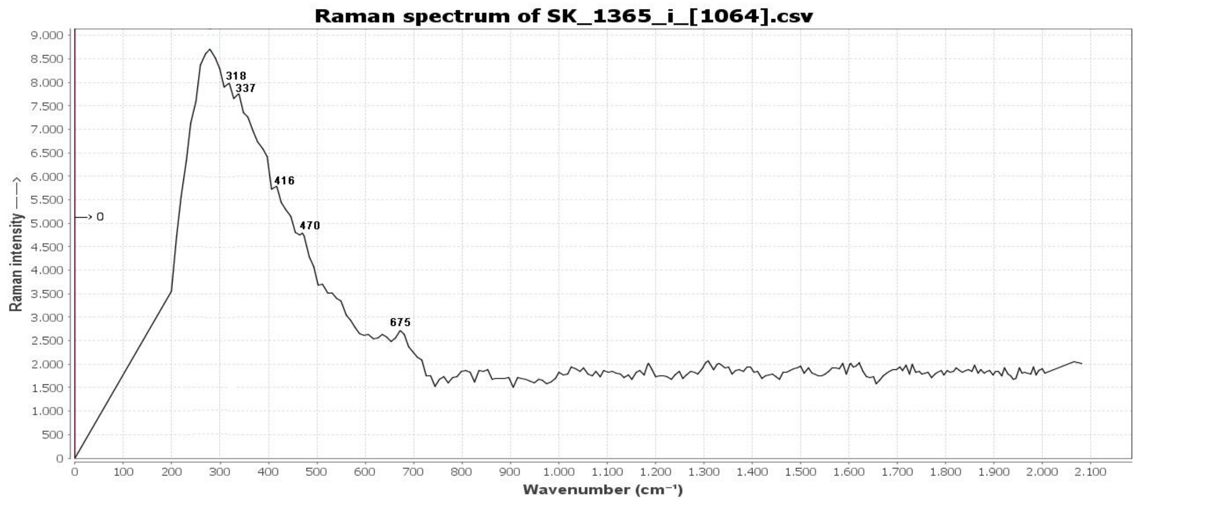
Fig. 1

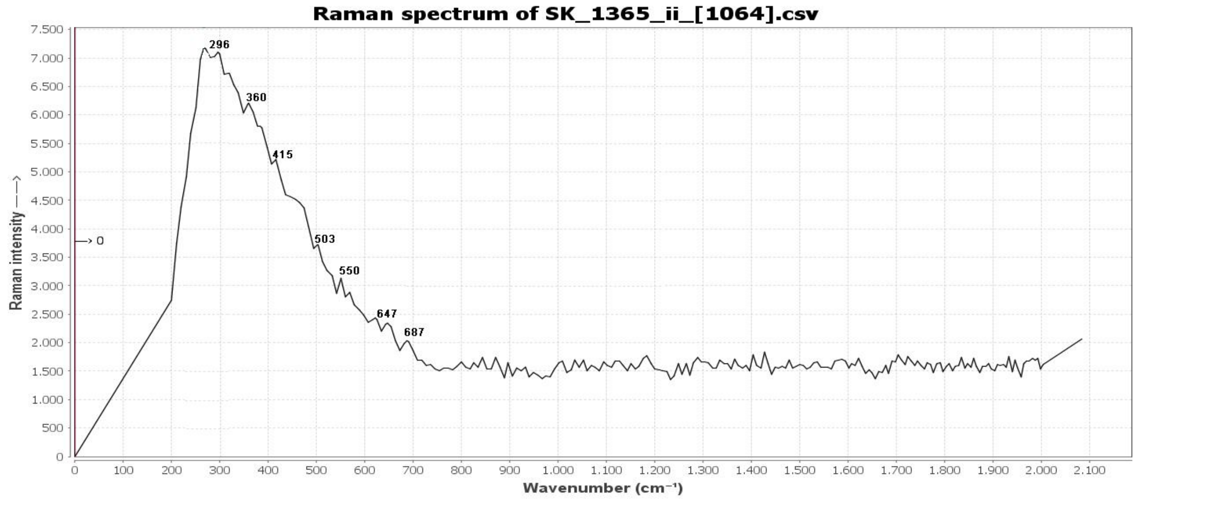
In addition, the central line which composes the body of the bird is not clear and it was not composed by only one clear cut as is usual when the cutting wheel is involved. The surface of the seal is not clear; a characteristic usually seen in seals on hard stones.

No. 34: CMS II, 3 No. 132 (excluded from the corpus)

		(Onassoglou 1985, p. 270 no. 26): steatite ARACHNE: steatite or serpentine
Seal	Impression	

Raman spectroscopy analysis





The Raman bands at 361, 470, 675, and 1052 cm^{-1} indicate the presence of steatite (talc).

The band at 675-680 cm^{-1} corresponds to the symmetric Si-O_b-Si bending vibration and is the characteristic Raman band for this mineral. Mohs' scale hardness: 1

Result

Minerals: brucite with amorphous silicon dioxite

Name of the stone: steatite

Mohs' scale hardness: 1

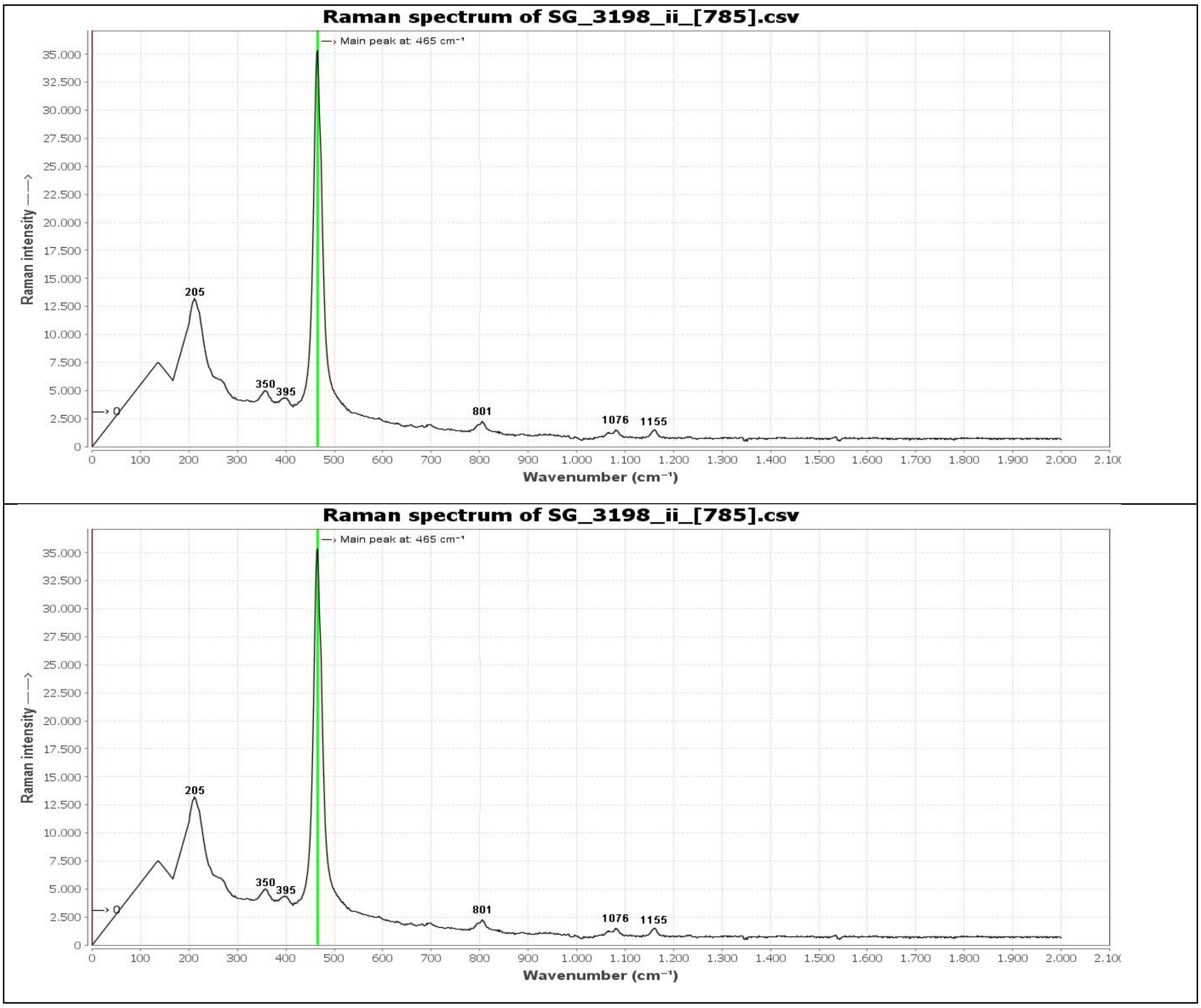
Analysis of the engraving

As in the previous example, in this case the cuts are not as clear as those seen usually in the hard stone seals. Therefore, these characteristics confirm we are dealing with the freehand technique applied on a soft stone.

No. 35: CMS III, 2 No. 487 (excluded from the corpus)

		Onassoglou (1985, p. 270 no. 29): carnelian ARACHNE: chalcedony
Seal	Impression	

Raman spectroscopy analysis



In all the spectra acquired from this sample, α-quartz (SiO_2) is the dominant mineral.

Carnelian is a translucent, bright orange to deep red chalcedony. Strictly speaking, it should not be banded or striated, but very often it is just the orange-red part cut out of a large agate. The name refers to its flesh-red colour. The colour is attributed to the presence of iron oxides and hydroxides (goethite 244, 299, 385, 480, 548, 681 cm^{-1}, hematite 225, 245, 290, 300, 412 cm^{-1}, lepidocrocite 250, 348, 379, 528, 650 cm^{-1}). Mohs' scale hardness of carnelian: 6-7.

Result

Name of the stone: carnelian

Mineral: α-quartz

Mohs' scale hardness: 6-7

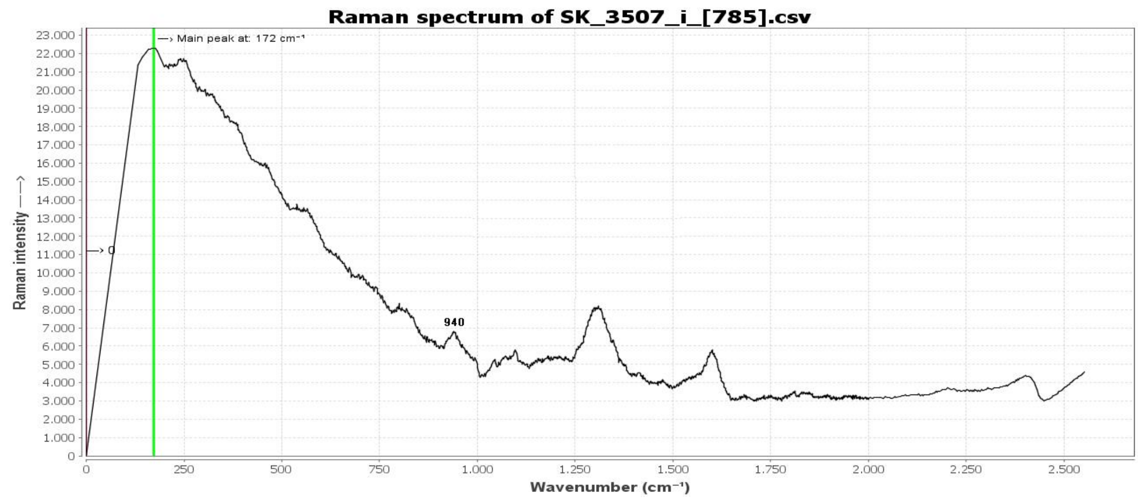
Analysis of the engraving

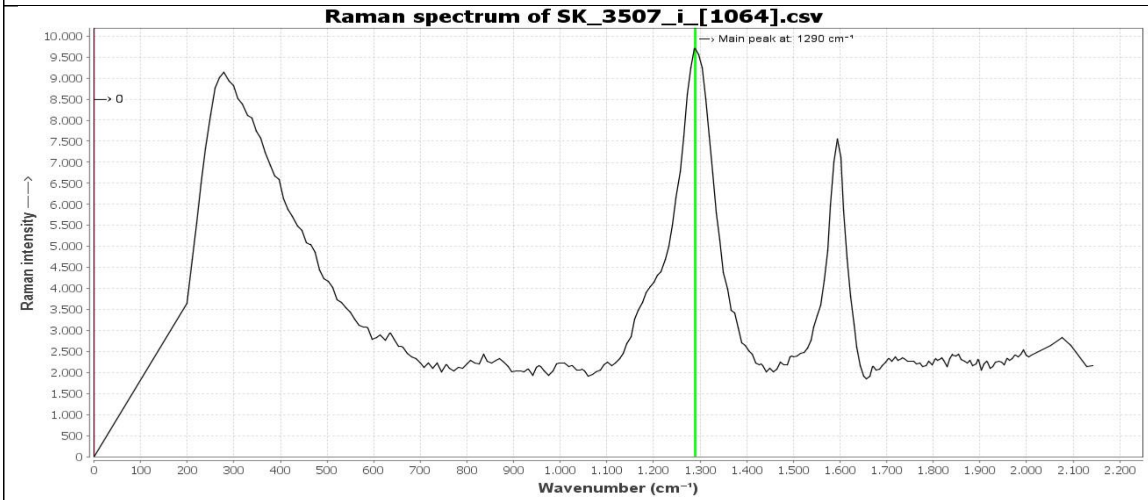
As can be seen, all the cuts are clear and they present the same thickness, which is indicative of the use of the lapidary lathe and, in addition, the seal-surface is very smooth as is usual in seals made from hard stones.

No. 36: CMS III No. 489 (excluded from the corpus)

		Onassoglou (1985, p. 270 no. 31): serpentine ARACHNE: limestone
Seal	Impression	

Raman spectroscopy analysis





For this seal, no resonant spectra for 785 and the 1064 nm lasers could be acquired. One Raman band at 940 cm^{-1} could be attributed to lawsonite but there is no adequate data to support this option. Mohs' scale hardness: 7.5. The bands in the region of 1300 – 1600 cm^{-1} are indicative of the presence of organic matter (carbon).

Result

Not clear

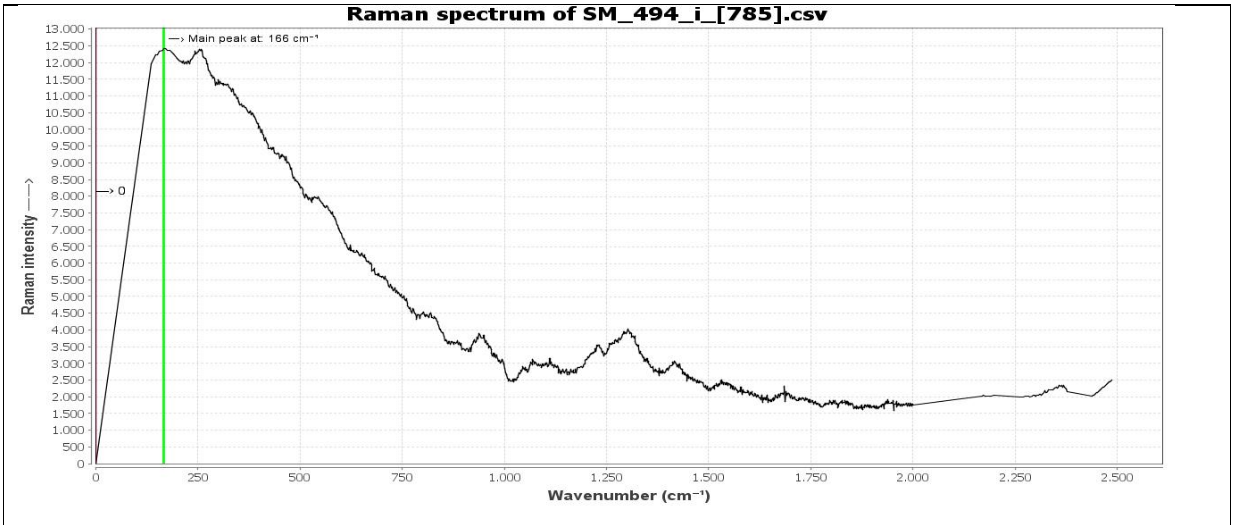
Analysis of the engraving

The cuts are not so precise as can be seen in the cuts which create the wings of the bird. In fact, the wings were not created by one single cut but two. This seems to be unusual for an artisan who used a cutting wheel and, for this reason it is more appropriate thinking the artisan used a knife instead. Thus, it is highly possible that the stone is soft.

No. 37: CMS IV No. 205 (UnS No. 75)

		Onassoglou (1985, p. 280 no. 43): serpentine ARACHNE: steatite or serpentine
Seal	Impression	

Raman spectroscopy analysis



No resonant spectra for the 785 and the 1064 nm lasers have been acquired. One Raman band at 940 cm^{-1} could be attributed to lawsonite but there is no adequate data to support this option. The bands in the region of 1300 – 1600 cm^{-1} are indicative of the presence of organic matter (carbon).

Result

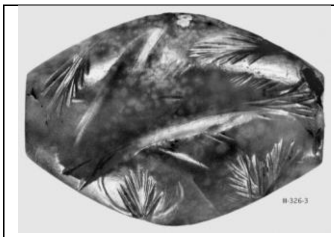
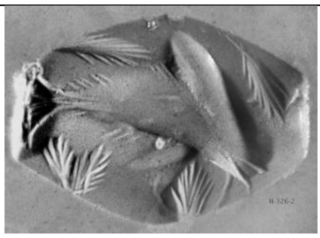
Not clear

Analysis of the engraving

Some cuts indicate that the cutting wheel was not used. In fact, the right wing was not made by a single cut but more than one (Fig. 1). Moreover, the circle which creates the head of the bird does not seem to be precise and this may mean that the tubular drill was used freehand. Therefore, this evidence indicates that we are dealing with a soft stone.

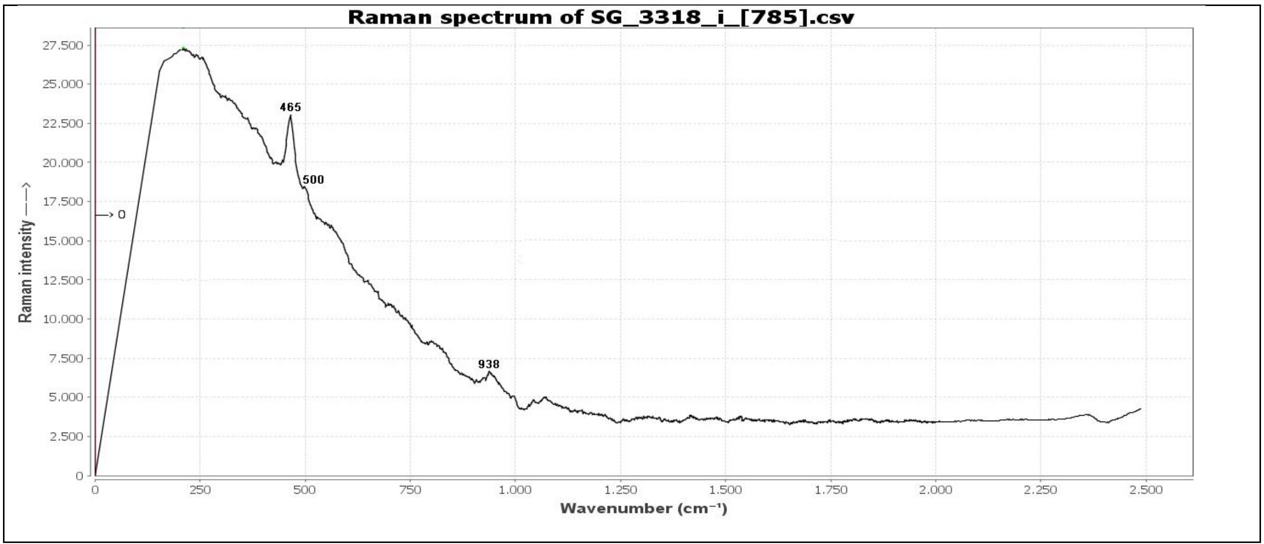
Fig. 1

No. 38: CMS III No. 326 (UnS No. 84)

<table>
<tr><td></td><td></td><td rowspan="2">Onassoglou (1985, p. 280 no. 37): chalcedony

ARACHNE: chalcedony (?)</td></tr>
<tr><td>Seal</td><td>Impression</td></tr>
</table>

<u>Raman spectroscopy analysis</u>



In all the spectra acquired from this seal, α-quartz (SiO_2) is the dominant mineral. Chalcedony is a general term referring to aggregates of parallel grown ("fibrous") quartz crystals of microscopic and sub-microscopic size. Agate and carnelian are types of chalcedony but in terms of hardness on the Mohs' scale, they all are within the range of 6-7. One Raman band at 940 cm^{-1} could be attributed to lawsonite but there is no adequate data to support this option.

<u>Result</u>

Mineral: α-quartz

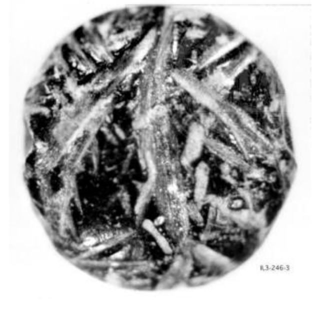
Name of the stone: chalcedony (blue colour)

Mohs' scale: 6-7

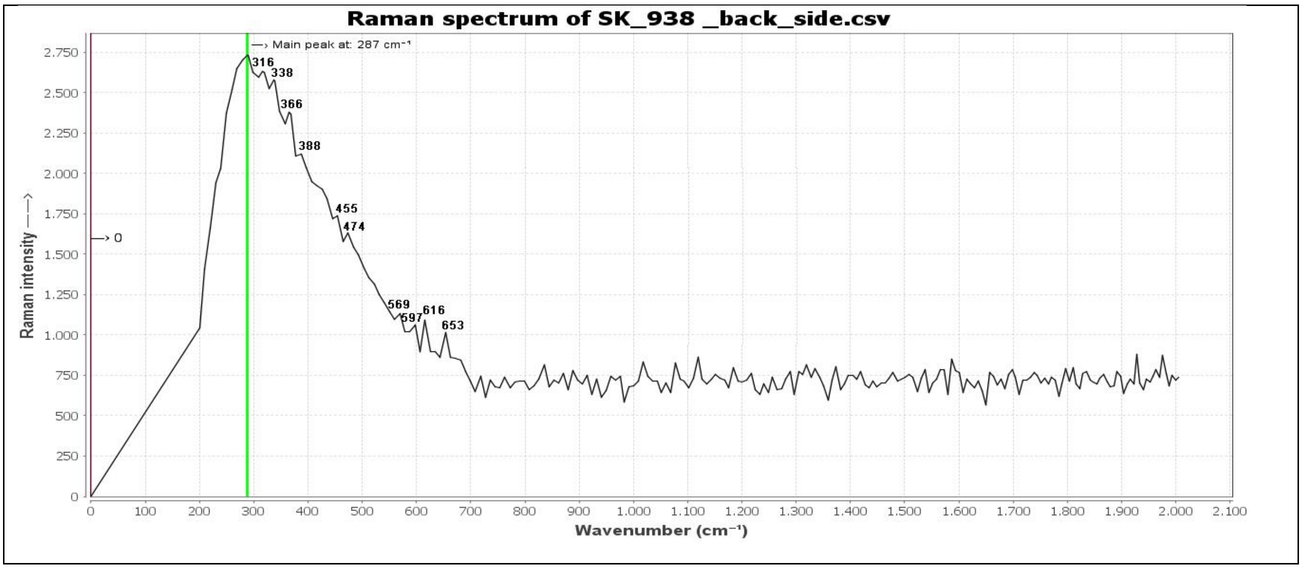
Analysis of the engraving

Undoubtedly, the cuts which compose this figure are made by the use of a cutting wheel and, therefore, the material is hard.

Seal No. 39 CMS II, 3 No. 246 (UnS No. 85)

		Onassoglou (1985, p. 277 no. 1): steatite ARACHNE: steatite or serpentine
Seal	Impression	

<u>Raman spectroscopy analysis</u>



The dominant and characteristic Raman bands of serpentine minerals (680, 690 cm^{-1}) and for talc (677 cm^{-1}) are not present in the spectra collected from this item. The Raman bands in the 650 – 750 cm^{-1} spectral region are assigned to the symmetrical stretching vibration (νs) of the Si-O_b-Si bridges. This band is characteristic of the mineral family of amphiboles. This family contains two main sub-groups: the orthorhombic and the monoclinic series (different crystallographic systems) with more than 15 member minerals. The important fact about the hardness in Mohs' scale is that all the members of the family of amphiboles is 5-6.

<u>Result</u>

Minerals: amphibole

Name of the stone: granite, diorite, andesite

Mohs' scale: 5-6

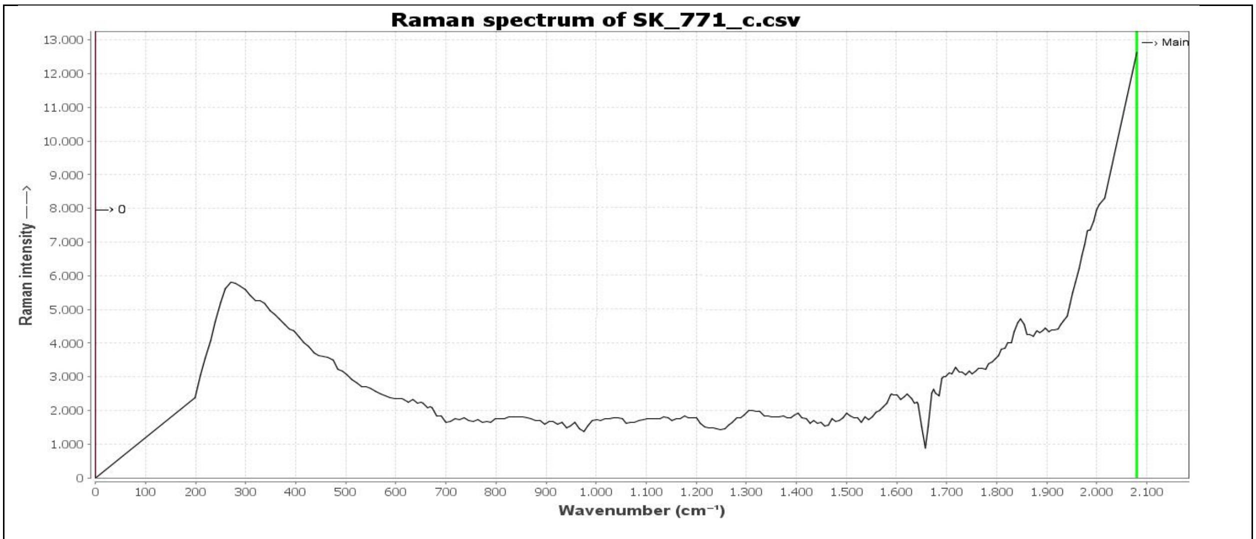
Analysis of the engraving

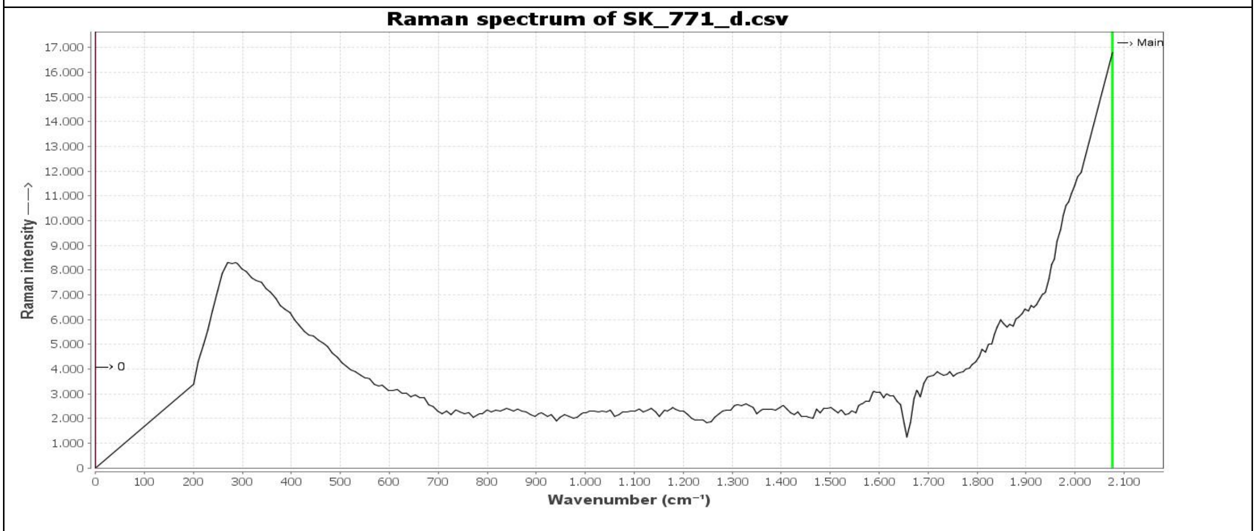
From the technical point of view, it seems that the central cut which creates the body of the fish is not straight and the cuts which compose the fins seem to present the same characteristic. Therefore, it does not seem that this stone was engraved by a cutting wheel. Moreover, the seal-surface is not homogeneous, so all these characteristics may be connected with very a hard material.

Seal No: 40 CMS II, 3 No. 268 (UnS No. 88)

		Onassoglou (1985, p. 292 no. 71): steatite ARACHNE: steatite or serpentine
Seal	Impression	

<u>Raman spectroscopy analysis</u>





Result

Not clear

Analysis of the engraving

Looking at the central cuts, they seem to have been made by a broad cutting wheel and the lines which contour the previous cuts present the same thickness. Yet, the creation of the cross-hatching suggests the use of the cutting wheel. These attestations strongly indicate the presence of a hard stone.

Conclusion

To sum up, although it was not possible to obtain a resonant spectrum for nine of the forty stones, the nature of the other thirty-one stones has been successfully identified through Raman spectroscopy analysis.

Summary

Seal-stones from the Archaeological Museum of Heraklion (Crete)				
Seals	**CMS References**	**Motif**	**Previous classification**	**Stone identification results**
No. 1	CMS IV No. 45D	Amphora	Onassoglou: sardonyx ARACHNE: agate?	Name of the stone: opal Mineral: moganite Mohs' scale hardness: 6
No. 2	CMS III, 2 No. 256	Jug	Onassoglou jasper ARACHNE: soft stone	Name of the stones: limestone Mineral: calcite Mohs' scale hardness: 3-4
No. 3	CMS II, 3 No. 311	Jug	Onassoglou: steatite ARACHNE: jasper?	Name of the stones: blueschist Mineral: lawsonite Mohs' scale hardness: 7.5
No. 4	CMS IV No. 227	Prow of ship	Onassoglou: sardonyx serpentine ARACHNE: agate	Name of the stone: agate Mineral: quartz Mohs' scale hardness: 7
No. 5	CMS IV No. 50D	Plants	Onassoglou: steatite ARACHNE: Serpentine or Slate	No spectrum obtained
No. 6	CMS II, 2 No. 16	Plants	Onassoglou: steatite ARACHNE: serpentine or slate	No spectrum obtained
No. 7	CMS IV No. 206	Plants	Onassoglou: marble ARACHNE: steatite or serpentine	No spectrum obtained
No. 8	CMS IV No. 148	Plants	Onassoglou: marble ARACHNE: serpentine?	Name of the stone: ophicalcite Mineral: calcite and serpentine (?) Mohs' scale hardness: 3-4
No. 9	CMS IV No. 152	Plants	Onassoglou: marble ARACHNE: steatite or serpentine	Name of the stones: blueschist Mineral: lawsonite Mohs' scale hardness: 7-7.5
No. 10	CMS III, 2 No. 267	Plants	Onassoglou: chalcedony	Name of the stone: agate Mineral: quartz Mohs' scale hardness: 7

			ARACHNE: hard stone	
No. 11	CMS II, 3 No. 37	Plants	Onassoglou: serpentine ARACHNE: steatite or serpentine	Name of the stone: steatite Mineral: olivine, basalt and andesite Mohs’ scale hardness: 1
No. 12	CMS II, 3 No. 144	Plants	Onassoglou: serpentine ARACHNE: steatite or serpentine	Name of the stone: serpentine Mineral: chrysotile/lizardite Mohs’ scale hardness: 2.5 to 3
No. 13	CMS II, 3 No. 255	Plants	Onassoglou: steatite ARACHNE: soft stone	Name of the stone: steatite Minerals: brucite/silicone dioxite (amorphous) Mohs’ scale hardness: 1
No. 14	CMS II, 3 No. 29	Cuttlefish	Onassoglou: jasper ARACHNE: soft stone	Name of the stone: banded limestone Mineral: calcite Mohs’ scale hardness: 3-4
No. 15	CMS II, 3 No. 229	Cuttlefish	Onassoglou: steatite ARACHNE: jasper?	Name of the stone: chalcedony Minerals: moganite/a-quartz Mohs’ scale hardness: 6
No. 16	CMS II, 3 No. 35	Cuttlefish	Onassoglou: steatite ARACHNE: steatite or serpentine	Name of the stone: it cannot be identified Minerals: Steatite/diopside/chrysotile Mohs’ scale hardness: 1
No. 17	CMS II, 3 No. 365	Cuttlefish	Onassoglou: hematite ARACHNE: jasper?	Name of the stone: hematite Minerals: hematite Mohs’ scale hardness 5.5 – 6.5.
No. 18	CMS II, 3 No. 143	Cuttlefish	Onassoglou: steatite ARACHNE: steatite or Serpentine	Name of the stone: serpentinite Minerals: serpentine /chrysotile/lizardite Mohs’ scale hardness: 2.5- 4
No. 19	CMS III, 2 No. 280	Cuttlefish	Onassoglou: jasper	No spectrum obtained

			ARACHNE: limestone?	
No. 20	CMS II, 3 No. 26	Octopus	Onassoglou: agate ARACHNE: carnelian?	Name of the stones: carnelian Minerals: moganite Mohs' scale hardness: 6-7
No. 21	CMS II, 3 No. 369	Octopus	Onassoglou: jasper ARACHNE: jasper?	Name of the stone: jasper (?) Minerals: Mineral /lawsonite Mohs' scale: hardness 7.5
No. 22	CMS IV No. 226	Bucranium	Onassoglou: sardonyx ARACHNE: agate?	Name of the stones: agate Mineral: a quartz Mohs' scale: of 6-7
No. 23	CMS IV No. 241	Panel	Onassoglou: marble ARACHNE: hard stone?	Name of the stone: hematite Mineral: hematite/glaucophane Mohs' scale hardness: 5.5-6.5
No. 24	CMS IV No. 41D	Wild goat	Onassoglou: marble ARACHNE: hard stone?	Name of the stone: chalcedony Mineral: moganite Mohs' scale hardness: 6-7
No. 25	CMS IV No. 180	Papyrus	Onassoglou: agate ARACHNE: agate?	Result: Calcite/Agate (banded chalcedony)/Glaucophane Regarding calcite: Mohs' scale hardness: 3 Regarding the silicate minerals: Mohs' scale hardness: 6 (moganite/glaucophane) -7 (agate)
No. 26	CMS II, 2 No. 149	Papyrus	Onassoglou: ivory ARACHNE: slate?	Name of the stone: slate Minerals: actinolite/diopside Mohs' scale hardness: between 5.5 to 6.5.
No. 27	CMS III, 2 No. 273	Papyrus	Onassoglou: hematite ARACHNE: serpentine?	No spectrum obtained
No. 28	CMS III, 2 No. 275	Papyrus	Onassoglou: steatite	No spectrum obtained

			ARACHNE: chlorite?	
No. 29	Onassoglou p. 269 No. 20 D. Levi ASAtene 39/40, 1961/62, 98. 143 Fig. 125 No. 17	Papyrus	Onassoglou: carnelian or sard	Name of the stone: chalcedony Minerals: α-quartz and moganite Mohs' scale hardness: 6-7
No. 30	CMS III, 2 No. 510 side a	Bird	Onassoglou: hematite ARACHNE: middle hard stone;	Name of the stone: marble (?) Minerals: calcite, iron oxi/ hydroxide and graphite Mohs' scale hardness: 3
No. 31	CMS II, 4 No. 168	Bird	Onassoglou: onyx ARACHNE: soft stone	Name of the stone: onyx Minerals: calcite Mohs' scale hardness: 3
No. 32	CMS II, 3 No. 94	Bird	Onassoglou: serpentine ARACHNE: steatite or serpentine	Name of the stone: Steatite Mineral: brucite with amorphous silicon dioxite Mohs' scale hardness: 1
No. 33	CMS II, 3 No. 356	Bird	Onassoglou: steatite ARACHNE: steatite or serpentine	Name of the stone: serpentinite Mineral: chrysotile/lizardite with indication of serpentinite Mohs' scale hardness: 2.5-3
No. 34	CMS II, 3 No. 132	Bird	Onassoglou: steatite ARACHNE: steatite or serpentine	Name of the stone: steatite Minerals: brucite with amorphous silicon dioxite Mohs' scale hardness: 1
No. 35	CMS III, 2 No. 487	Bird	Onassoglou: carnelian ARACHNE: chalcedony?	Name of the stone: carnelian Mineral: α-quartz Mohs' scale hardness: 6-7
No. 36	CMS III, 2 No. 489	Bird	Onassoglou: serpentine ARACHNE: limestone	No spectrum obtained
No. 37	CMS IV No. 205	Bird	Onassoglou: serpentine	No spectrum obtained

			ARACHNE: steatite or serpentine	
No. 38	CMS III, 2 No. 326	Fish	Onassoglou: chalcedony ARACHNE: chalcedony (?)	Name of the stone: chalcedony (blue colour) Mineral: α-quartz Mohs' scale: 6-7
No. 39	CMS II, 3 No. 246	Fish	Onassoglou: steatite ARACHNE: steatite or serpentine	Name of the stone: granite, diorite, andesite Minerals: amphibole Mohs' scale: 5-6
No. 40	CMS II, 3 No. 268	Isolated motif	Onassoglou: steatite ARACHNE: steatite or serpentine	No spectrum obtained

Despite the data obtained, it is necessary to clarify two terms for correctly classifying two types of stones: serpentine refers to the mineral (serpentine family of minerals: lizardite, chrysotile, antigorite), so serpentinite is the correct term to classify the stone. Although steatite is another term very frequently used by the archaeological community, the correct geological term for that mineral/stone is talc and/or soapstone.

The presence of lawsonite for some of the stones and that its hardness is 7.5 is new data. In fact, the maximum hardness within the corpus of the talismanic stones was 7, and this indicates that artisans must have used a very powerful powder to engrave these very hard materials. Another new fact is related to the use of opal, which so far is a unique example for this class of seals. Finally, the methods used for updating the materials in ARACHNE are sometimes not correct.