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The Minoan Shipwreck at Pseira, Crete

by

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with contributions by

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6

Ceramic and Lead Weights from the Shipwreck and along the Coast

by

Joanne E. Cutler,[†] Thomas M. Brogan, and Todd Whitelaw

Twenty-four ceramic weights and a single lead weight were recovered during the underwater excavations at Pseira (Figs. 25, 26; Pls. 13, 14). These weights come from two very different contexts. The first is the deep water of the shipwreck site (ca. 33–45 m deep); the second is the shallower water near the Minoan settlement on the island that probably contains material from the settlement. Here, at a depth of 13 m, divers identified remains of a sunken quay that probably formed part of the Minoan harbor not far from where they recovered the second group of weights, at a depth of 5–30 m.

Four of the ceramic weights and the lead weight (176) were recovered from the shipwreck, which dates to MM IIB. The four terracotta weights are discoid in shape (177–180 [07/113, 08/135, 08/136, 09/171]) with either one (177, 180 [07/113, 09/171]) or two (178, 179 [08/135, 08/136]) suspension holes. The upper edge of three weights (177–179 [07/113, 08/135, 08/136]) is flat; the upper edge of another one (180, 09/171) is marked by a shallow groove. When found on Cretan Bronze Age sites, these objects are typically identified as

loomweights, but at least some may have served as fishing weights (Giner 2010, 76–78). Context remains the best guide, and in this case, the context of a shipwreck suggests that these tools may have served as weights for fishing nets or lines with hooks.

Several recent studies of fishing equipment from the Mediterranean illustrate the range of materials (e.g., terracotta, stone, lead) and shapes of fishing weights (cylindrical, disk-shaped, spherical, spindle-shaped, conical) used from the Bronze Age to Roman era (Galili, Rosen, and Sharvit 2002; Bernal Casasola 2010, 96–103). While varied, the technology of terracotta, stone, and lead weights does not change much over the millennia (Marzano 2013, 28–32). In this light, the terracotta weights from Pseira would have been suitable for either the casting or trawling versions of the net or to sink a baited hook on a casting line (Bernal Casasola 2010; Giner 2010).

The lead weight (176, 07/110) is long, thin, and pierced with a hole at each end, although along perpendicular axes (Fig. 25; Pl. 13). It may

belong to a rare class of perforated hook and line sinkers produced by casting and described as off-center lead weights in the typology of Mediterranean fishing weights (Kuniholm 1982, 301–309; Galili, Rosen, and Sharvit 2002; Bernal Casasola 2010, 110–111). They were used for trawling, where the shape helped prevent tangled lines. While fishing technology in the ancient Mediterranean proved remarkably resistant to change, an MM II date for this object is unlikely. The only known Mediterranean weights of this type were recovered from the Yassi Ada shipwreck, which dates to late antiquity (Kuniholm 1982, 301–309; Bernal Casasola 2010, 111). A similar chronology for the Pseira weight is suggested by the significant Early Byzantine remains on Pseira Island and Mochlos (Betancourt 2005, 296–304.)

The remaining 20 discoid terracotta weights were found underwater near the Minoan settlement. Seventeen are round, with either one (NL 81, NL 83–NL 85, NL 88, NL 89, NL 92, NL 93, NL 95, NL 96 [06/B35, 06/B39, 06/B45, 06/B46, 07/B70, 07/B72, 07/B77, 07/B79, 07/B84, 08/B85]) or two (NL 82, NL 86, NL 87, NL 94, NL 97, NL 99, NL 100 [06/B38, 06/B47, 07/B66, 07/B83, 08/B86, 09/B95, 09/B96]) suspension holes. Three weights are elliptical, and all are pierced with a single suspension hole (NL 90, NL 91, NL 98 [07/B73, 07/B76, 09/B92]). Eight of the weights have a flattened top without an impressed groove (NL 82, NL 83, NL 88, NL 92–NL 94, NL 96, NL 97 [06/B38, 06/B39, 07/B70, 07/B77, 07/B79, 08/B85, 07/B83, 08/B86]), two have a flattened top and a groove (NL 86, NL 87 [06/B47, 07/B66]), four have a groove without a flattened top (NL 85, NL 90, NL 91, NL 98 [06/B46, 07/B73, 07/B76, 09/B92]), and six have neither feature (NL 81, NL 84, NL 89, NL 95, NL 99, NL 100 [06/B35, 06/B45, 07/B72, 07/B84, 09/B95], 09/B96).

Although found in the water, these 20 weights are not related to the shipwreck. At least three suggestions can be posited to explain the unusual findspot. First, the weights may have been in MM II houses that later became submerged either because of tectonic activity that caused portions of the coastline of Crete to sink below sea level (Soles, McCoy, and Suka 2017) or because of eustatic changes that caused rising sea levels around the island (Theodorakopoulou et al. 2009). Second, the weights may represent MM II material thrown into the sea during later rebuilding of the town in LM

I. In both scenarios, the weights probably represent suspension weights for the warp of a vertical loom that was used on Crete throughout the Bronze Age (Barber 1991; Burke 2010; Cutler 2011). Third, the weights were found close to a sunken quay, so it is also possible that they were being used as weights for fishing with casting lines, like those used today in Cretan harbors, or awaiting use as net weights.

Because all the clay weights from the shipwreck and the underwater region near the settlement conform in fabric, shape, size, weight, and characteristics to Minoan discoid loomweights (one or two suspension holes, often flattened tops, and impressed grooves), we thought it would be useful to examine their features for use on the warp-weighted loom. The four ceramic weights from the shipwreck site have complete or estimated weights ranging from 107 to 173 g and measure 1.8–2.6 cm thick. The 20 weights from underwater near the settlement, hereafter referred to as “underwater,” have complete or estimated original weights ranging from 72 to 203 g and measure 1.5–2.7 cm thick. As shown in Illustration 6.1, these ranges are consistent with the larger sample of terracotta loomweights recovered during the 1984–1992 investigations at the adjacent settlement on Pseira in terms of height (settlement: $n=36$, mean = 7.2 cm; underwater: $n=17$, mean = 7.1 cm), diameter (settlement: $n=38$, mean = 6.5 cm; underwater: $n=15$, mean = 7.1 cm), and weight (settlement: $n=25$, mean = 118.3 g; underwater: $n=12$, mean = 114.0 g). The larger sample includes a few rare shapes, but most are discoid weights and represent all of the underwater sample. From the settlement, 45% are elliptical discoid, whereas only three of the 24 underwater weights (12.5%) are elliptical. For both samples, weights with the relevant parts preserved usually have one suspension hole (settlement 71%, underwater 62.5%); for those with their top preserved, most have a flattened top (settlement 68%, underwater 56.5%), while a smaller subset have an impressed groove (settlement 16.5%, underwater 30.4%). Together, these similarities strongly suggest that all of the terracotta weights documented here were originally manufactured as loomweights. Those from the shipwreck, or even some of those recovered closer to the island, if in situ rather than dumped or eroded from the settlement, might have been repurposed as net or line weights. It has been documented that, at least in the Neopalatial period, some loomweights appear to have been

moved between communities in the southern Aegean, perhaps taken with them by mobile weavers as models for producing new full sets at their destinations (Cutler 2012). With this in mind, those from the shipwreck could have been in transit for future use elsewhere as loomweights, although it is perhaps more likely that they were used as weights onboard.

Pursuing the comparison with the weights recovered from the adjacent settlement, most of those with a secure context are from Neopalatial deposits, but some of the unstratified examples could have been from earlier phases, potentially contemporary with those discussed here. Compared directly in terms of the key functional characteristics of weight and thickness, which determine how the loomweights could have been used on the warp-weighted loom, the current sample is consistent with that from the settlement (Ill. 6.1). A slight bimodal distribution can be seen in both dimensions, suggesting a tendency toward two focal production strategies, using light and narrow weights or heavier and thicker weights. The weights documented here illustrate a similar bimodality, though less clearly because of the much smaller sample. But with these

examples dating to MM II, this hints at a long-term multiple strategy for cloth production at Pseira.

Using the methodology developed by the Center for Textile Research in Copenhagen (Anderson Strand and Nosch, eds., 2015), we estimated the most suitable thread types and some characteristics of the fabrics probably produced by these loomweights using a warp-weighted loom (cf. Brogan and Cutler 2017). The calculations in Illustration 6.2 are for the most basic tabby or plain weave, in which the horizontal weft passes alternately over one warp thread and under the next, with the next weft threads reversing this order, produced using two rows of loomweights.

From disparate contexts, there is no suggestion that any of these weights would have been used together on the same loom, so they simply give us an overview of the sorts of thread with which they could have been used and the density of the weave of the fabrics they could have been used to produce. The weights from the shipwreck would all have been suitable for use with very thin thread, needing only ca. 5–10 g tension, while the heavier weights might also have been used with thin

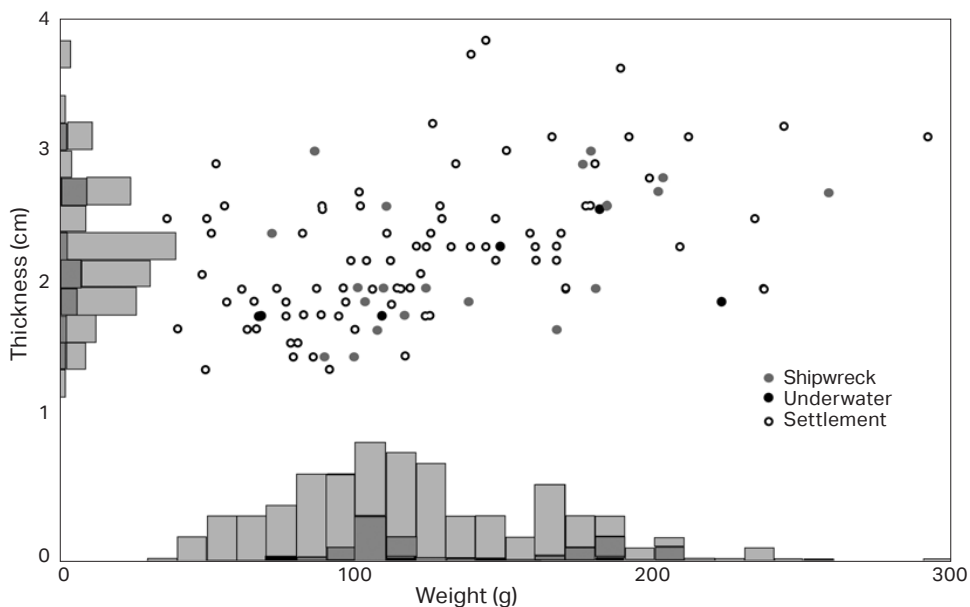


Illustration 6.1. Weights from the MM II shipwreck and underwater settlement, plotted by thickness and estimated complete weight. Loomweights (primarily Neopalatial) from the 1984–1992 excavation and cleaning of settlement contexts on Pseira Island are plotted on the left axis for comparison. The slight bimodal tendency in both datasets suggests two production strategies.

Catalog Number	Excavation Number	Preservation (%)	Preserved Weight (g)	Estimated Complete Weight (g)	Thread Thickness (cm)	Thread Count (per cm) with Various Tensions (in g)				
						Very Thin 5 g	Very Thin 7.5 g	Very Thin 10 g	Thin 15 g	Thin 20 g
Shipwreck										
179	08/136	100	109	109	1.8	24	17	12	—	—
180	09/171	95	107	113	2.1	22	14	10	—	—
178	08/135	100	148	148	2.3	26	17	13	9	—
177	07/113	95	173	182	2.6	—	18	14	9	—
Underwater Part of the Minoan Settlement										
NL 86	06/B47	100	72	72	2.4	12	8	—	—	—
NL 91	07/B76	100	86	86	3	11	7	—	—	—
NL 87	07/B66	100	90	90	1.5	24	16	—	—	—
NL 89	07/B72	100	99	99	1.5	27	17	13	—	—
NL 98	09/B92	100	101	101	2	20	13	10	—	—
NL 81	06/B35	100	103	103	1.9	22	15	11	—	—
NL 99	09/B95	95	102	107	1.7	22	15	12	—	—
NL 85	06/B46	100	109	109	2	22	15	11	—	—
NL 90	07/B73	100	110	110	2.6	17	12	8	—	—
NL 84	06/B45	75	87	116	1.8	26	17	13	—	—
NL 97	08/B86	95	118	124	2	25	17	12	—	—
NL 82	06/B38	100	138	138	1.9	29	19	15	—	—
NL 100	09/B96	85	142	167	1.7	—	26	20	13	—
NL 95	07/B84	85	150	176	2.9	—	16	12	8	—
NL 83	06/B39	80	143	179	3	—	16	12	8	—
NL 93	07/B79	>70	135	180	2	—	24	18	12	—
NL 88	07/B70	75	138	184	2.6	—	19	14	9	—
NL 96	08/B85	>70	151	201	2.7	—	20	15	10	7
NL 94	07/B83	100	203	203	2.8	—	19	14	10	7
NL 92	07/B77	>50	142	258	2.7	—	—	19	13	10

Illustration 6.2. Middle Minoan II clay discoid weights from the underwater excavations at Pseira: weight (preserved and estimated complete), thread thickness, and the calculated thread count per cm when used with threads requiring different tensions in a tabby weave. Weights are sorted by estimated complete weight, indicating a tendency toward two production strategies.

thread requiring 15 g tension (for a visual approximation of thread types ranging from very thin to very thick, see Andersson Strand, Nosch, and Cutler 2015, fig. 6.1.2).

For the weights excavated closer to the settlement, in Illustration 6.2, which is ranked by increasing estimated complete weight, **NL 86** (06/B47) and **NL 91** (07/B76) are thick for such small weights and would not have allowed as densely woven a cloth as could have been achieved with the other weights. The remaining weights divide into two groups around 150 g and 2.5 cm, consistent with the two major clusters of loomweights from the settlement. The lighter and thinner weights would be optimal for use with very thin thread with 5–10 g tension to produce a dense weave, while the heavier and thicker weights would work best with very thin to thin threads with 7.5–15 g tension to produce a slightly less dense weave. The densest weaves are likely to have been fairly balanced in terms of the density of warp and weft threads, whereas those with fewer warp threads may have been a more open weave or may have had a higher number of weft threads so those would have been weft dominant. For the Protopalatial period on Crete, most recovered loomweights are from larger institutional contexts, from the palaces at Knossos and Phaistos and from Quartier Mu at Malia, although more domestic contexts are probably represented from collections from the Royal Road South at Knossos and the workshop houses in Quartier Mu at Malia. While there are some collections of loomweights within the thickness and weight ranges documented for this sample, the weights recovered from the palace at Phaistos and Quartier Mu include many thicker and heavier examples and would have been used with thicker thread, probably to produce heavier cloth with more open or weft-dominant weaves (Cutler 2011, 150–153, 173–175, 181–187). The weights documented here all lie within the finer and denser end of this overall spectrum of textile production, often, although not exclusively, represented in domestic contexts.

A similar pattern of production was observed in the contemporary MM II discoid weights from the dye-working installation at Alatzomouri Pefka near Pacheia Ammos (Cutler and Brogan 2020). The analysis of that material also indicates that more than one variety of textile could have been produced

with this type of thread: a relatively dense, balanced textile or a more open or weft-dominant textile.

Catalog of the Clay and Lead Weights

Shipwreck

176 (07/110; Fig. 25; Pl. 13). Lead weight, complete. Pres. L. 8.2; pres. w. 1.5; th. 0.9 cm; wt. 92 g. Elliptical shape, with a single hole (d. 0.5 cm) at one end. *Comments:* depth 41 m; from grid square $\Lambda\Pi\Pi\Sigma$. Byzantine.

177 (07/113; Fig. 25; Pl. 13). Discoid loomweight, 95% complete. Pres. w. 8.4; h. 8.0; th. 2.6 cm; pres. wt. 173 g. A coarse phyllite fabric (weak red, 2.5YR 4/2). Round shape, with a flattened top and single hole near the upper edge (d. 1.6 cm). *Comments:* depth 36.7 m; from grid square $\Psi\Omega\alpha 3\alpha 2$. MM IIB.

178 (08/135; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 7.8; h. 7.4; th. 2.3 cm; wt. 148 g. A medium-coarse phyllite fabric (reddish brown, 5YR 5/4). Round shape, with a flattened top and two holes near upper edge (d. 1.1 cm) near the upper edge. *Comments:* depth 42.7 m; from the perimeter southeast of **127**. MM IIB.

179 (08/136; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 7.3; h. 7.1; th. 1.8 cm; wt. 109 g. A medium-coarse phyllite fabric (reddish brown, 5YR 5/4). Round shape, with a flattened top and two holes (d. 0.6 cm) near upper edge. *Comments:* depth 42.7 m; from the perimeter southeast of 08/13. MM IIB.

180 (09/171; Fig. 25; Pl. 13). Discoid loomweight, 95% complete. W. 6.4; h. 7.0; th. 2.1 cm; pres. wt. 107 g. A medium-coarse phyllite fabric (reddish brown, 5YR 6/4). Round shape, with a grooved top and a single hole (d. 0.6 cm) near upper edge. *Comments:* depth 41.2 m; from grid square $\Pi\alpha 10\alpha 9P$, level 1. MM IIB.

Underwater Part of the Minoan Settlement

NL 81 (06/B35; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 6.6; h. 6.6; th. 1.9 cm; wt. 103 g. A medium-coarse phyllite fabric (yellowish red, 5YR 5/6). Round shape, with a single hole (d. 0.9 cm) near upper edge. *Comments:* depth 20 m. MM IIB

NL 82 (06/B38; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 7.4; h. 7.1; th. 1.9 cm; wt. 138 g. Fabric is not visible. Round shape, with a flattened top and two holes (d. 0.6 cm). *Comments:* depth 17 m. MM IIB.

NL 83 (06/B39; Fig. 25; Pl. 13). Discoid loomweight, ca. 80% complete. Pres. w. 7.2; pres. h. 7.1; th. 3.0 cm; pres. wt. 143 g. A medium-coarse phyllite fabric (mostly red, 2.5YR 5/6). Round shape, with a flattened top and a single hole (d. 1.6 cm) near upper edge. *Comments:* depth 24 m. MM IIB.

NL 84 (06/B45; Fig. 25; Pl. 13). Discoid loomweight, ca. 70–75% complete. Pres. w. 7.3; pres. h. 6.4; th. 1.8 cm; pres. wt. 87 g. A medium-coarse fabric (yellowish red, 5YR 5/6). Round shape, with a single hole (d. 1.1 cm) near upper edge. *Comments:* depth 16 m. MM IIB.

NL 85 (06/B46; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 6.8; h. 6.9; th. 2.0 cm; wt. 109 g. A medium-coarse phyllite fabric (dark brown, 7.5YR 4/4). Round shape, with a grooved top and a single hole (d. 0.8 cm) near the upper edge. *Comments:* depth 16 m. MM IIB.

NL 86 (06/B47; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 5.4; h. 5.3; th. 2.4 cm; wt. 72 g. A medium-coarse Mirabello Fabric (light red, 2.5YR 6/6). Round shape, with a flattened and slightly grooved top and two holes (d. 0.7 cm) near upper edge. *Comments:* depth 16 m. MM IIB.

NL 87 (07/B66; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 7.3; h. 6.9; th. 1.5 cm; wt. 90 g. A medium-coarse phyllite fabric (red, 2.5YR 4/6). Round shape, with a flattened and grooved top and two holes (d. 0.8 cm) near upper edge. *Comments:* depth 16 m. MM IIB.

NL 88 (07/B70; Fig. 25; Pl. 13). Discoid loomweight, edges chipped, more than 70% complete. Pres. w. 7.5; pres. h. 7.2; th. 2.6 cm; pres. wt. 138 g. A medium-coarse phyllite fabric (red, 2.5YR 4/8). Round shape, with a flattened top and a single hole (d. 1.7 cm) near upper edge. *Comments:* depth 11 m. MM IIB.

NL 89 (07/B72; Fig. 25; Pl. 13). Discoid loomweight, complete. W. 7.9; h. 7.8; th. 1.5 cm; wt. 99 g. A medium-coarse phyllite fabric (light red, 2.5YR 6/6). Round shape, with a single hole (d. 1.6 cm) near upper edge. *Comments:* depth 12 m. MM IIB.

NL 90 (07/B73; Fig. 26; Pl. 14). Discoid loomweight, complete. W. 5.6; h. 6.6; th. 2.6 cm; pres. wt. 110 g. A medium-coarse phyllite fabric (brown, 7.5YR 5/4). Elliptical shape, with a grooved top and a single hole (d. 0.7 cm) near upper edge. *Comments:* depth 35 m. MM IIB.

NL 91 (07/B76; Fig. 26; Pl. 14). Discoid loomweight, complete. W. 5.0; h. 5.8; th. 3.0 cm; wt. 86 g. A medium-coarse phyllite fabric (red, 2.5YR 5/6). Elliptical shape, with a slightly grooved top and a single hole (d. 0.8 cm) near the upper edge. *Comments:* depth 7 m. MM IIB.

NL 92 (07/B77; Fig. 26; Pl. 14). Discoid loomweight, more than 50% preserved. Pres. w. 7.1; pres. h. 6.9; th.

2.7 cm; pres. wt. 142 g. A medium-coarse phyllite fabric (red, 2.5YR 5/4). Round shape, with a flattened top and a single hole (d. 1.7 cm) near upper edge. *Comments:* depth 7 m. MM IIB.

NL 93 (07/B79; Fig. 26; Pl. 14). Discoid loomweight, edges chipped, more than 70% complete. Pres. w. 7.9; pres. h. 7.2; th. 2.0 cm; pres. wt. 135 g. A medium-coarse phyllite fabric (red, 2.5YR 5/6). Round shape, with a flattened top and a single hole (d. 2.0 cm) near the upper edge. *Comments:* depth 30.5 m. MM IIB.

NL 94 (07/B83; Fig. 26; Pl. 14). Discoid loomweight, complete. W. 8.5; h. 8.1; th. 2.8 cm; pres. wt. 203 g. A medium-coarse phyllite fabric (reddish brown, 5YR 5/4). Round shape, with a flattened top and two holes (d. 0.8 cm) near upper edge. *Comments:* depth 5 m. MM IIB.

NL 95 (07/B84; Fig. 26; Pl. 14). Discoid loomweight, ca. 85% complete. Pres. w. 7.0; h. 7.6; th. 2.9 cm; pres. wt. 150 g. A medium-coarse phyllite fabric (reddish brown, 5YR 5/3). Round shape, with a single hole (d. 1.3 cm) near upper edge. *Comments:* depth 5 m. MM IIB.

NL 96 (08/B85; Fig. 26; Pl. 14). Discoid loomweight, edges chipped, more than 70% complete. Pres. w. 6.9; pres. h. 8.2; th. 2.7 cm; pres. wt. 151 g. A medium-coarse phyllite fabric (reddish brown, 2.5YR 4/4). Round shape, with a flattened top and a single hole (d. 1.8 cm) near the upper edge. *Comments:* depth 16 m. MM IIB.

NL 97 (08/B86; Fig. 26; Pl. 14). Discoid loomweight, ca. 95% complete. W. 7.4; h. 7.3; th. 2.0 cm; pres. wt. 118 g. A medium-coarse phyllite fabric (reddish brown, 2.5YR 4/4). Round shape, with a flattened top and two holes (d. 0.6 cm) near upper edge. *Comments:* depth 16 m. MM IIB.

NL 98 (09/B92; Fig. 26; Pl. 14). Discoid loomweight, complete. W. 6.7; h. 7.4; th. 2.0 cm; wt. 101 g. A medium-coarse phyllite fabric (red, 2.5YR 4/6). Elliptical shape, with a grooved top and a single hole (d. 0.6 cm) near the upper edge. *Comments:* depth 13 m. MM IIB.

NL 99 (09/B95; Fig. 26; Pl. 14). Discoid loomweight, ca. 95% complete. W. 7.0; h. 7.1; th. 1.7 cm; pres. wt. 102 g. A medium-coarse phyllite fabric (reddish brown, 5YR 4/4). Round shape, with two holes (d. 0.9 cm) near upper edge. *Comments:* depth not recorded. MM IIB.

NL 100 (09/B96; Fig. 26; Pl. 14). Discoid loomweight, ca. 80% complete. W. 8.5; pres. h. 8.3; th. 1.7 cm; pres. wt. 142 g. A medium-coarse phyllite fabric (reddish brown, 2.5YR 4/4). Round shape, with two holes (d. 0.8 cm) near upper edge. *Comments:* depth 13 m. MM IIB.



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FIGURE 25

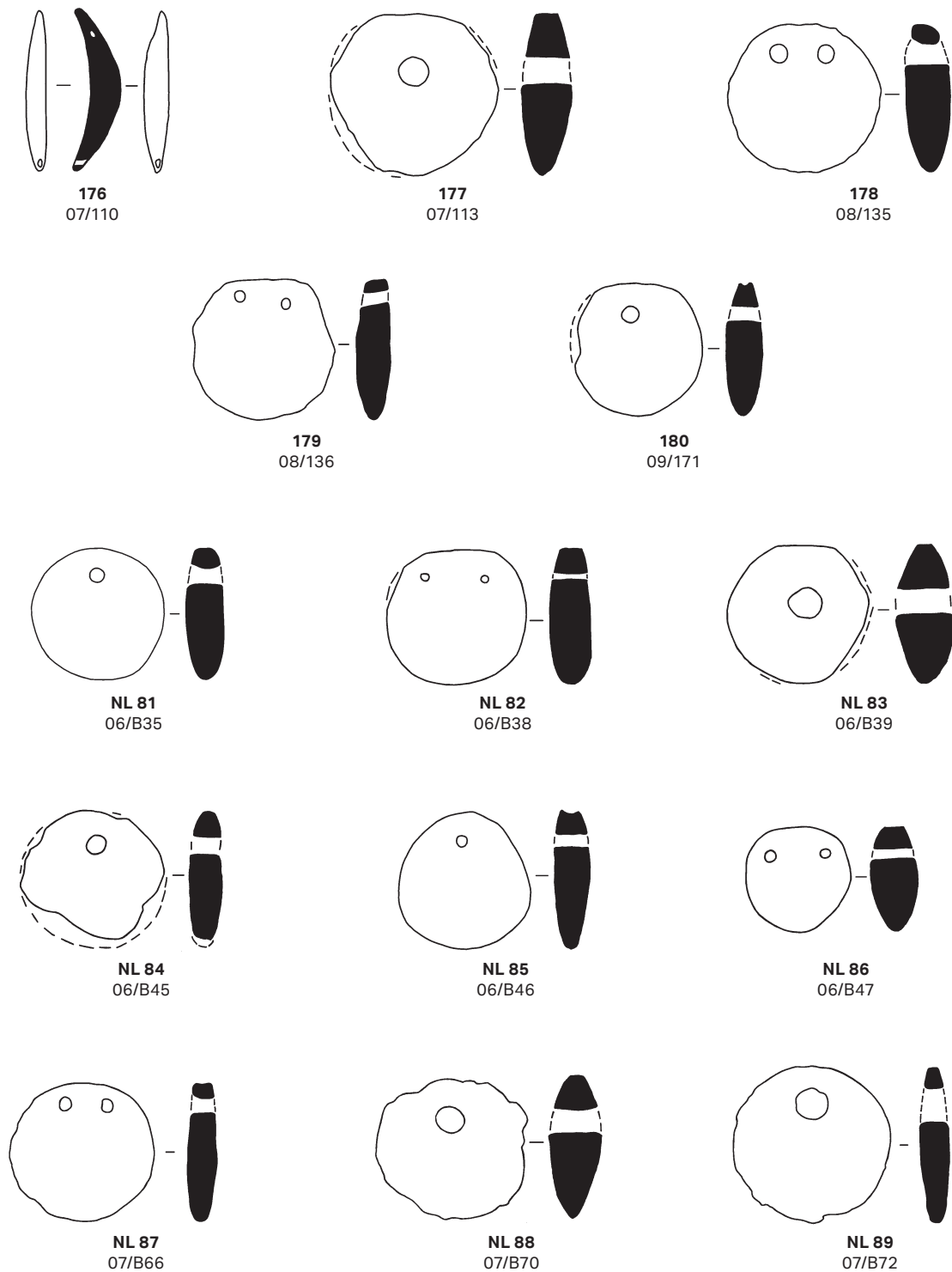


Figure 25. Single lead weight (176) and clay weights (177–180). Some weights not from the shipwreck (NL 81–NL 89).
Scale 1:3. Drawing L. Bonga.

FIGURE 26

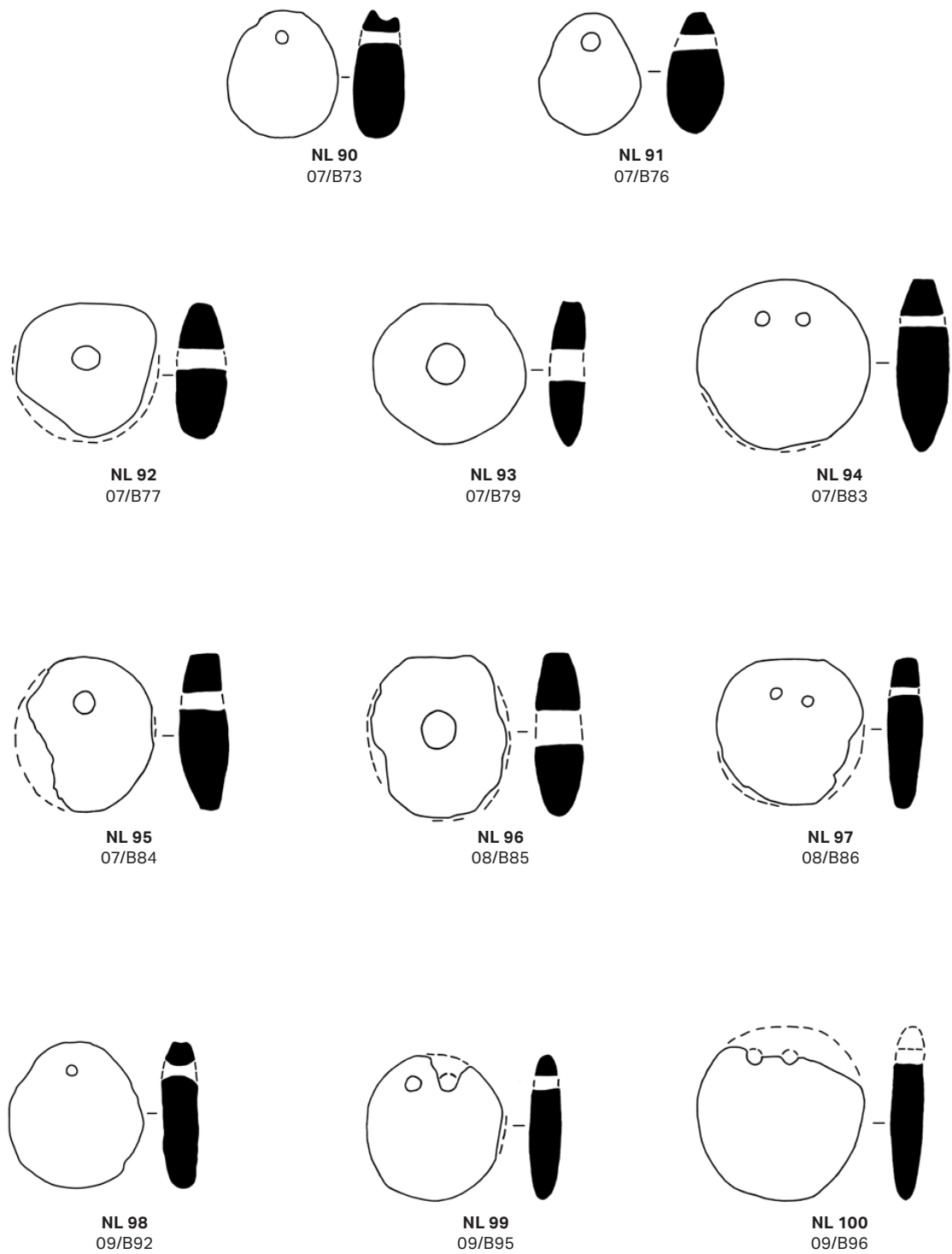


Figure 26. Clay weights (NL 90–NL 100) not from the shipwreck. Scale 1:3. Drawing L. Bonga.



176
07/110



177
07/113



178
08/135



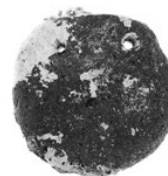
179
08/136



180
09/171



NL 81
06/B35



NL 82
06/B38



NL 83
06/B39



NL 84
06/B45



NL 85
06/B46



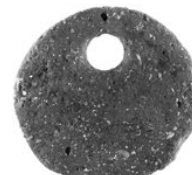
NL 86
06/B47



NL 87
07/B66



NL 88
07/B70



NL 89
07/B72

Plate 13. Single lead weight (176) and clay weights (177–180). Some weights not from shipwreck (NL 81–NL 89).
Scale 1:3. Photos C. Papanikolopoulos.

PLATE 14



NL 90
07/B73



NL 91
07/B76



NL 92
07/B77



NL 93
07/B79



NL 94
07/B83



NL 95
07/B84



NL 96
08/B85



NL 97
08/B86



NL 98
09/B92



NL 99
09/B95



NL 100
09/B96

Plate 14. Ceramic weights not from shipwreck. Scale 1:3. Photos C. Papanikolopoulos.