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Chalcolithic, 5th Millennium BC, Copper Smelting at Timna

New radiocarbon dating evidence for Timna Site 39

The earliest copper smelting furnace and workshop found up to date – Site 39 in the Southern Arabah (Israel) – and the copper smelting technology it represented (at the time of its discovery the earliest known anywhere),¹ was dated by diagnostic archaeological finds to the Chalcolithic Period (5th-4th millennium BC). This date was of fundamental importance for the history of metallurgy – and became the subject of repeated controversies mainly based on the lack of scientific confirmation by C14 (see IAMS No. 15/16, 1990, 9-12). A recently obtained radiocarbon date of an ash sample from the excavation of Site 39 by the Oxford University Acceleration Unit was (calibrated) 4460 BC (95.4% confidence) 4240 BC, which fully confirmed the archaeological date proposed at the time by the excavators of Site 39. Site 39 is the earliest Chalcolithic smelting site recorded in the Near East.



Fig. 1: Site 39 before excavation. In foreground on the right, the furnace site and slag concentration (39B). Below the hill, the oval workshop area with the three tumuli-habitations (39A) and the ancient path leading up to the smelting site. In the background, the Arabah rift valley and the mountains of Jordan.

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The archaeology of Site 39

Site 39, located in the Wadi Nehushtan in the Arabah Valley, at the entrance to the modern Timna Mines Co, is one of many prehistoric copper smelting sites on the foothills along the western fringe of the southern Arabah Valley. Discovered by Rothenberg in 1960 (Rothenberg 1962, 58-60), it was excavated in 1965² (Rothenberg, Tylecote and Boydel 1978; Rothenberg (ed.) 1990, 4-8). The site (Fig. 1) consisted of an oval-shaped, enclosure-like, line-up of small working places (29x23m) and three ruined buildings, one of which was excavated in 1965 (Site 39A). From this workshop a well-trodden ancient path led up the adjacent hill and here, right above the workshop, a concentration of small slag lumps, ore nodules, charred, slagged rocks, stone mortars and pestles indicated the smelting location of Site 39 (Site 39B). A number of diagnostic flint objects were found on the surface of Site 39A and B during the survey, before the excavation of the site.

Site 39A: Already before the excavation, the finds at the actual work locations (forming the oval 'enclosure') – crushing tools, nodular copper ore, flint implements and a quantity of small, crushed slag lumps – indicated metallurgical activities, though there was no evidence for actual smelting at Site 39A. Ephraim Yavin dated the flint tools to the Chalcolithic period, a date later confirmed by Professor M. Stekelis,



Fig. 2 The excavated habitation of Site 39A. At the right lower corner near the entrance, the cooking stove (source of the ash sample for the new C14 dating).

Director of the Department of Prehistory, Hebrew University, Jerusalem (Rothenberg 1962, 8; chapter III).

The building excavated at Site 39A (Fig. 2) was an oval structure, 4.5x5.5m, about 1.5m high, which apparently had served as the enclosure of a hut-like structure of wood, skin or cloth. It had a circular pebble floor in its centre and next to it a small pit full of dark ashes, apparently a fire place. This structure must have served as a habitation as no signs of any other use were found. The archaeological finds inside this structure included numerous flint tools and flakes, some pottery, several simple hammerstones and animal bones. Right next to the entrance to this building was a small cooking stove, found still full of ashes. The ash sample for the new, recent C14 dating originated from this stove.³

Site 39B: The copper smelting furnace found in the excavation (Fig. 3) was a simple, bowl-shaped hole-in-the ground (about 25-40cm in diameter and 40cm deep), with a low superstructure of small rocks (Rothenberg et al. 1978, 6-7). It was the most

Fig. 3 Site 39B: the smelting installation.



primitive smelting 'installation' found anywhere, especially if compared with the advanced Egyptian New Kingdom smelting furnaces of the Timna sites nearby. Slagged and sintered pieces of unlined furnace wall were found scattered around the furnace together with some slagged rocks from the superstructure. Many small, crushed or broken pieces of slag were found dispersed around the furnace but also over much of the hill top, indicating that there must have been more than one furnace operating at Site 39B, so far undetected.

The viscous, non-tapped slag contained a lot of metallic copper pellets and was obviously raked out of the furnace at the end of the smelting process and crushed to small fragments in order to mechanically recover the entrapped metallic copper. The analysis of the slag proved that fluxing with iron oxide was already known at Site 39, though it was still lacking the proper control of the smelting charge and other process parameters. As such, the slag of Site 39 represented a distinct type, characteristic for the first step in the Chalcolithic period towards advanced copper smelting (Rothenberg and Merkel in press)

On the hard surface around the furnace a number of archaeological finds were found: flint implements (Fig. 4) and a few sherds, besides many small lumps of crushed slag. It is important to point out that this hard surface went right up to the kerb of the furnace and was evidently the actual working floor of the furnace and the finds on it were in situ. The flint tools found on this floor, the same as all the flint implements found at Site 39A+B, date to the Chalcolithic period.⁴

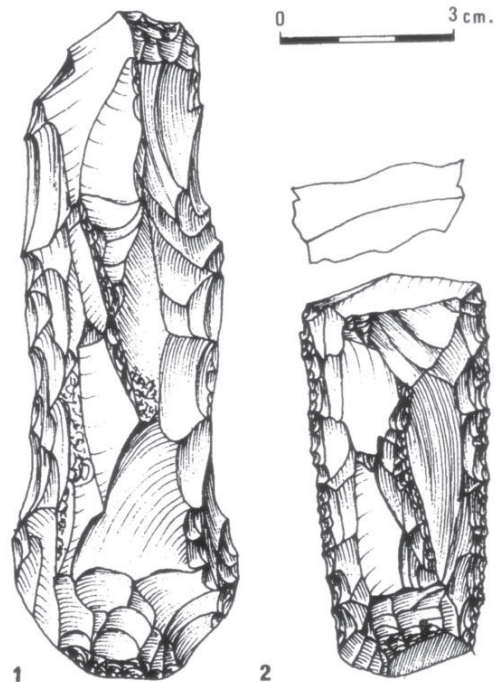


Fig. 4 Typical Chalcolithic flint axes from Site 39.

Dating Site 39: The smelting technology of Site 39, with its typical rather primitive furnace and slag, represents an important step in the development of copper metallurgy (Rothenberg, ed., 1990; Rothenberg and Merkel in press) and its secure dating is, therefore, of considerable importance for archaeo-metallurgy.

In the recent excavation at the late Chalcolithic site of Abu Matar, near the town of Beersheba (Gilead et al. 1992), crushed slag pieces, pieces of copper ore and crucible and smelting furnace fragments were found which, for the first time, proved that not only metallic copper was worked at this settlement but that copper was also smelted there from imported ore. Most of the slag of Abu Matar and other Ghassulian-Beersheba culture sites in the Beersheba region, looked very similar to the slag of Site

39 and it was therefore assumed that Abu Matar and Site 39 are approximately of the same age, i.e. the later part of the 4th millennium BC (Bercovici 1978, 18; Rothenberg et al. 1978, 8). During our inspection of the metallurgical finds from Abu Matar, we identified a large, slagged furnace fragment, which was obviously part of a mortar-lined smelting furnace. Its preserved curvature indicated a furnace diameter of about 35cm. Although the slag at Abu Matar was apparently of the same Chalcolithic type as the slag of Site 39 – indicating a similar technological horizon of copper smelting at both sites – this type of furnace was obviously further advanced than the primitive hole-in-the-ground smelting ‘installation’ of Site 39. Both sites evidently belong to the Chalcolithic period (5th-4th millennium BC), but the overall technology at Site 39, especially its smelting furnace, suggests an earlier phase within this period. However, since the dating of Site 39 was based on the diagnostic flint tools found at Site 39A and B and these type of tools are recorded throughout the Chalcolithic period, it was not possible to obtain a more precise date for Site 39 within this period.

The ‘controversy’ about the date of Site 39⁶

In 1973, J.D. Muhly voiced his doubt about any site in Timna dating to a period before Early Bronze II, although at that time the archaeological finds of Site 39 had not been published and Muhly could not have seen them without our knowledge in the store of the Arabah Expedition. Muhly argued: ‘While little of the early material has been published thus far, it seems doubtful that anything at Timna is really earlier than EBII (Early Bronze II – 2850-2650 BC).’ In his ‘review’ of our Timna research in 1984 – i.e. after the publication of our monograph about Site 39 and Bercovici’s paper on the date of the flint finds (Rothenberg et al. 1978) – Muhly (1984) goes even further: ‘I know of nothing found at any of the mining or smelting sites at Timna that need to be dated earlier than the later part of the Egyptian New Kingdom...Rothenberg has never published any hard evidence in support of the Chalcolithic dating of Site 39.’ Muhly (1984) even suggested that the flint objects of Site 39 may be as recent as the Iron Age. At first, since prehistorians and, especially, archaeo-metallurgists dealing with the region had accepted the Chalcolithic character and date of Site 39 (Bachmann 1978, 22; Tylecote 1962, 25-29; 1976, 6-7; 1978, 28-29), it did not make much sense to enter into an argument with Muhly, who is a historian and not a metallurgist or archaeologist, about the lithic industries of the Arabah and Sinai or about prehistoric extractive metallurgy. However, since Muhly was repeatedly quoted as the expert for the date of the metallurgical sites of Timna and Sinai, one of the present authors (B.R.) published what he considered to be convincing arguments against Muhly’s opinionated views, hoping that this would bring an end to this rather futile situation (Rothenberg 1987, 1-7; 1990a, 9-12). Since Muhly’s views about the date of Site 39 and its metal technology are still being quoted as factual evidence when considered convenient (e.g. Adams and Genz 1995 19 n.4),⁶ we once more mention this ‘controversy’, which now, after we have obtained a C14 date for Site 39, seems even more out of place.

A new C14 date for Site 39

As mentioned above, a sample of ash from the cooking stove of Site 39A was recently located among the findboxes of the excavation and dated by the Acceleration Unit of the Research Laboratory for Archaeology and the History of Art, Oxford University:

Timna Site 39, Israel
OxA-7632 Timna 39, 15, charcoal, ? ash 5485 ± 45 BP
Calibrated (M. Stuiver and R.S.Kra eds. *Radiocarbon* 28 (2B): 805-1030, we receive the date : 4460BC (95.4% confidence) 4240 BC.

The new C14 date of Site 39 in the 5th millennium BC provides significant support for the concept of several metallurgical developmental phases within the Chalcolithic period, towards the end of which stands the Ghassulian-Beersheba metallurgy as found at Abu Matar. Site 39 evidently represents a very early, perhaps even the earliest step towards proper copper smelting technology and as such has a secure place in the history of metal.

Beno Rothenberg and John Merkel

Notes:

- 1 The earliest smelting workshop found to date is Site F2 in the Timna Valley, which is dated Late Pottery Neolithic - see *IAMS* No.19, 1995.
- 2 The (late) archaeologist Ephraim Yevin was first in charge of the excavation of the workshop, whilst Rothenberg was excavating the furnace on the hill above. Because of sudden illness, Ms Yevin left the excavation at the end of its first week. The finds during this week were recorded by Ms Yevin, boxed and stored. The ash sample recently radiocarbon dated in Oxford was one of these few early samples and had been overlooked. Luckily, it was noticed by its mark “for C14” when all the finds from Site 39 were taken over for permanent storage by the Israel Antiquity Authorities.
- 3 Right after the excavation in 1965, ash samples from inside the habitation were sent to the British Museum for C14 dating but there was not enough carbon left to date the samples. The sample of ash recently dated by the Oxford Accelerator Unit was one of the first samples taken by Ephraim Yevin.
- 4 The flint objects from the excavation of Site 39 were published by A. Bercovici (in Rothenberg et al. 1978) and dated to the Chalcolithic period with similarities to the Ghassul and Beersheba flint industries of the later 4th millennium BC. However, no traces of the Ghassulian-Beersheba culture have ever been found in the Arabah mining regions, not at Fenan or at Timna, and the flints of Site 39 do in fact belong to a local, almost pure flake industry and in spite of some similarities to the Ghassulian, is, according to our surveys in the Arabah and Sinai, of a much wider chronological range, i.e. the 5th to 4th millennium BC. See also Rothenberg and Glass 1992.
- 5 See Rothenberg, 1990a, 9-12, for a previous review of the dating controversy around Site 39.
- 6 Adam and Genz (1995) published their excavation of Fidan 4 as “A Chalcolithic village complex” in the Fenan region. According to the character of the archaeological finds from this excavation, the lack of any pottery and flint typical for the Ghassulian-Beersheba culture of the northern Negev, as well as the late 4th millennium C14 date quoted by the authors, we would relate the site of Fidan 4 to Early Bronze I and not to the Chalcolithic period.

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